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PREFACE.

In a year in which the community generally has suffered so much from financial difficulties, and in which the government has been occupied with party discussions and foreign wars, we may esteem it fortunate that both in architecture and engineering no retrogradation has taken place. Although architecture has no great memorials of the present year to show us, yet its labours have been great, while its prospects are most promising, and if neither remarkable for the completion nor the commencement of any gigantic design, it can scarcely be denied that the present is a period of the brightest augury. The necessity for the New Courts of Law may be considered as acknowledged, while the appointment of new judges makes their erection more urgent, the appointment of a commission to consider in what way the Fine Arts can best be made available in the New Houses of Parliament, with the addition of the Victoria Record Tower to the plan of that building, the recognized advantage to be derived from the embankment of the Thames—all these are circumstances which are calculated to inspire the greatest satisfaction.

While prospects of employment are being opened to the profession, its general advancement may be looked upon with equal pleasure; the question of competition is one which has been much agitated during the present year, and good can scarcely fail to arise from the mode in which the extra-professional press have entered into the discussion. The arts have for the first time been made a part of general education by the appointment of Mr. Dyce, at King's College, to a professorship of this branch of instruction, and in the same institution a school of architecture is also formed, so that architecture may henceforth be regarded as adopted into the universitary system. The legislature in the late session took, upon a bold and comprehensive scale, a plan for the application of architectural police and hygiene, and political difficulties alone retarded measures, the principle of which was generally admitted. In the sister country the late representative of the crown followed up the bestowal of royal patronage on the Institute of Irish Architects by conferring on its president Sir Richard Morrison, the honour of knighthood, and in the present Viceroy, the long honoured President of the Institute here, we hope to see a generous encourager of all the liberal arts. The extension of museums, and the re-opening of Westminster Abbey are measures calculated to promote the moral welfare of architecture, while its material interests have not been neglected. A general improvement and extension of the royal parks has been commenced, the Green Park, Hyde Park, Regent's Park, and Windsor Park are undergoing extensive alterations, a new Royal Kitchen Garden is to be formed, the Kitchen Garden in Kensington Gardens removed, the East of London to be improved by the opening of Victoria Park, and other Parks are contemplated in the South. The new streets in the metropolis and the improvements in Trafalgar Square have proceeded but slowly, but the difficulties with regard to them have now been overcome. The new street to the Post Office has however been cleared, and the approaches to the Royal Exchange nearly completed. The strike of a large body of masons caused considerable delay with the Houses of Parliament and the works in Trafalgar Square, otherwise the new buildings have gone on well. The Royal Stables at Windsor and the Wesleyan Centenary Hall, have been completed; St. Bartholomew's Hospital has been extended, the Lock Hospital commenced, and a Gresham Lecture Hall: restorations and decorations are proceeding in the Cathedral of Hereford, Westminster Abbey, the Chapel of St. George Windsor, and King's College Cambridge; and the Round Churches in the Temple and at Cambridge; many new Churches have been erected in various parts of the country. The demolition of the old front of the British Museum has commenced, to make way for a new one, but we have this year lost the Great Armoury in the Tower, Astley's Amphitheatre and Vauxhall. The greatest loss architecture has sustained has been by the death of the illustrious Schinkel.

Directing our attention to engineering we find the converse of what we have observed with regard to architecture, for many noble works have been completed, while the continuance of legislative restrictions threatens to check the progress of every department of civil engineering. It may be said, without any important exceptions, that neither for railways, canals or harbours has any act been passed, and mechanical engineering alone remains unscathed. The government instead of affording relief to engineering, brought forward measures which must still further have depressed it, had they not been defeated in the attempt.

In the Colonies we have to notice the increased employment of engineers, particularly in New Zealand. The Bengal Government have at last published a report on the public works, executed by them, and it appears that the other Indian governments have of late been stimulated to carry on extensive improvements of the canals and roads of India.

With regard to the institutions we feel it our duty to point out as a deed worthy of the profession and of the man, the munificent conduct of President Walker, who presented to the Institute one thousand pounds consols as a prize fund. The Institute has shown a praiseworthy disposition to commemorate the great men of the profession, by calling for a series of memoirs. Dublin has been added to the number of engineering universities, courses have been opened in University College, a school is proposed at Manchester, a junior school has been opened at King's College, and a school for engine drivers at the Polytechnic Institution. The first benevolent institution connected with the profession has been founded for the relief of workmen, by the mechanical and marine engineers.

It is with pleasure we chronicle among the events of the year, the knighthood of Sir Isambard Brunel, and the completion of the great works of himself and his son, the Thames Tunnel and the Great Western Railway. The King of the Belgians has also conferred the order of Leopold upon the younger Stephenson.

PREFACE.

One of the most striking features of this year has been the number and importance of the scientific questions which have been agitated. They relate mostly to the phenomena of steam and the construction of engines, impelled by it. They include the discussion on the electricity of steam, on the percussive action attributed to it, on the comparative merits of Cornish and other engines, and of four and six wheel locomotives, and on the combustion of coal. The plans for the improvement of the river Irwell were also made the subject of a public disputation, in which several engineers of eminence took part.

The deaths among eminent men connected with the profession have not been numerous; they are those of Francis Bramah, the engineer, John Rickman, the author of the Life of Telford, and Sir Francis Chantrey, the eminent sculptor.

This year has witnessed the completion of nearly all the railways, for which acts have passed, and we may date from this period the establishment of a connected railway system. The number of miles executed this year is under two hundred and fifty, but the Great Western, South Western and Gosport, Manchester and Leeds, Brighton, Stockton and Hartlepool, and Blackwall Railways have been opened throughout. Additional and partial openings have taken place of the Bristol and Exeter, Manchester and Sheffield, Cheltenham and Great Western, North Eastern, Maryport and Carlisle, Glasgow and Greenock, and Ulster Railways. The Greenwich line is being widened, and the locomotive system has been extended to the Cromford and High Peak Railway. The sudden and unaccountable occurrence of serious accidents on the lines in the autumn of the last year and of the present, gave rise to violent attacks on the railways from the press, and to the suggestion of stringent measures on the part of the Board of Trade, which was however defeated in the attempt. The inefficiency of the Act of last year has been signally shown by the closing of the Brighton Railway shortly after the government inspector had pronounced it to be not only in an efficient state, but to be the best executed work of any that he had seen. A bill for railways in Ireland was introduced by the government, who were compelled to modify it, and it has since been postponed. Not only our engineers, but our workmen, have been called abroad for the execution of the Paris and Rouen Railway, and the Suspension Bridge over the Danube at Pesth.

Wood pavement has been adopted in the neighbourhood of chuches and courts of law, for the purpose of deadening the sound, and it has been laid down on an extensive scale in several of the principal thoroughfares of the metropolis.

The repairs of the bridges over the Thames have been proceeded with, and an extensive embankment of the river is contemplated; the Hungerford Suspension Bridge is in progress, the Thames Tunnel has been opened throughout, and the lighthouse with Mitchell's screw moorings on the Maplin Sands has been finished. A lighthouse on the same construction has been erected at Fleetwood, and many improvements made in the harbour there. A lighthouse entirely of iron has also been constructed in this country and sent out to Jamaica. The Docks at Southampton notwithstanding many difficulties are nearly ready for opening.

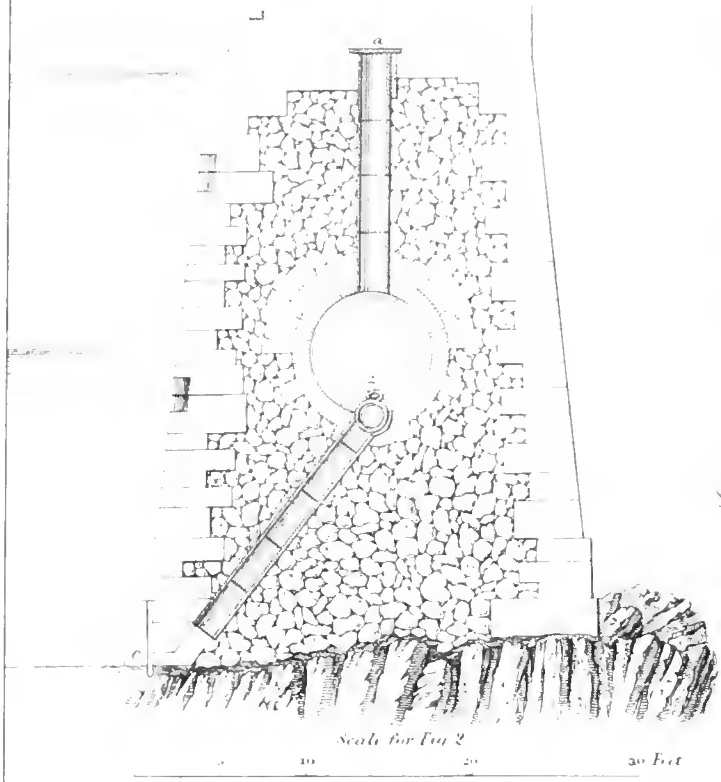
The extended use of iron steamers, with that of auxiliary steam power, and the attention devoted to the forms of propellers are the principal things which strike us with regard to marine engineering, together with the progress of sounder views as to the proportions of power to tonnage, and the bulk of the engine. The loss of the President excited much notice in the early part of the year, but no injurious influence to ocean steam navigation has resulted from that casualty. The West India Mail Steamers have been completed, and steam navigation has been extended to theHavannah, to the Upper Elbe, and in Australia. Ocean steam towing has been tried in the Straits of Gibraltar. The war with China has afforded full opportunity for testing the iron war steamers, and proving their value, and the steam navy has been greatly increased.

Gas has been introduced in Sydney, a prelude to its extension in the Australian Continent.

Mechanical engineering has found much employment; although the depression of trade has prevented the erection of new factories, the demand for the export trade has continued to increase. Turkey and many other countries have availed themselves of the skill of our mechanics.

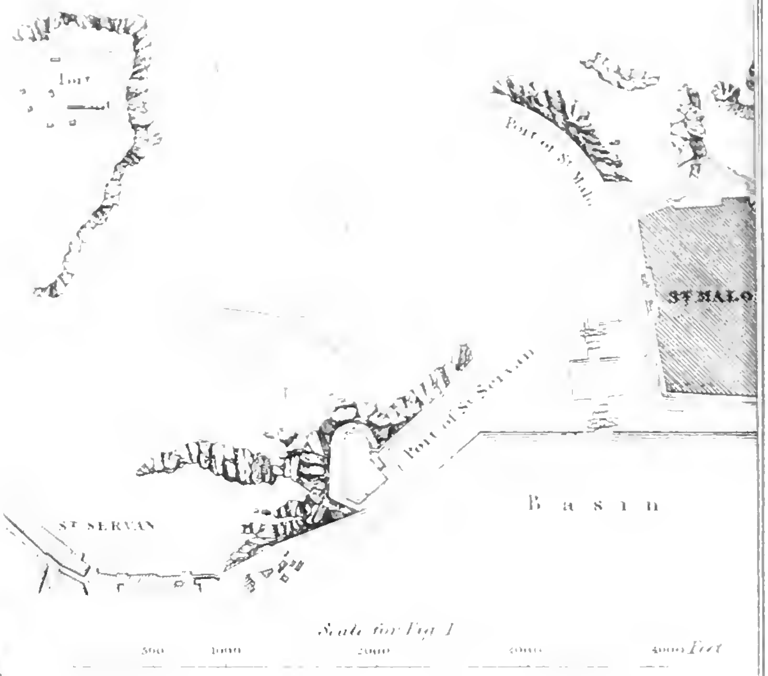
Transverse Section

Fig 2



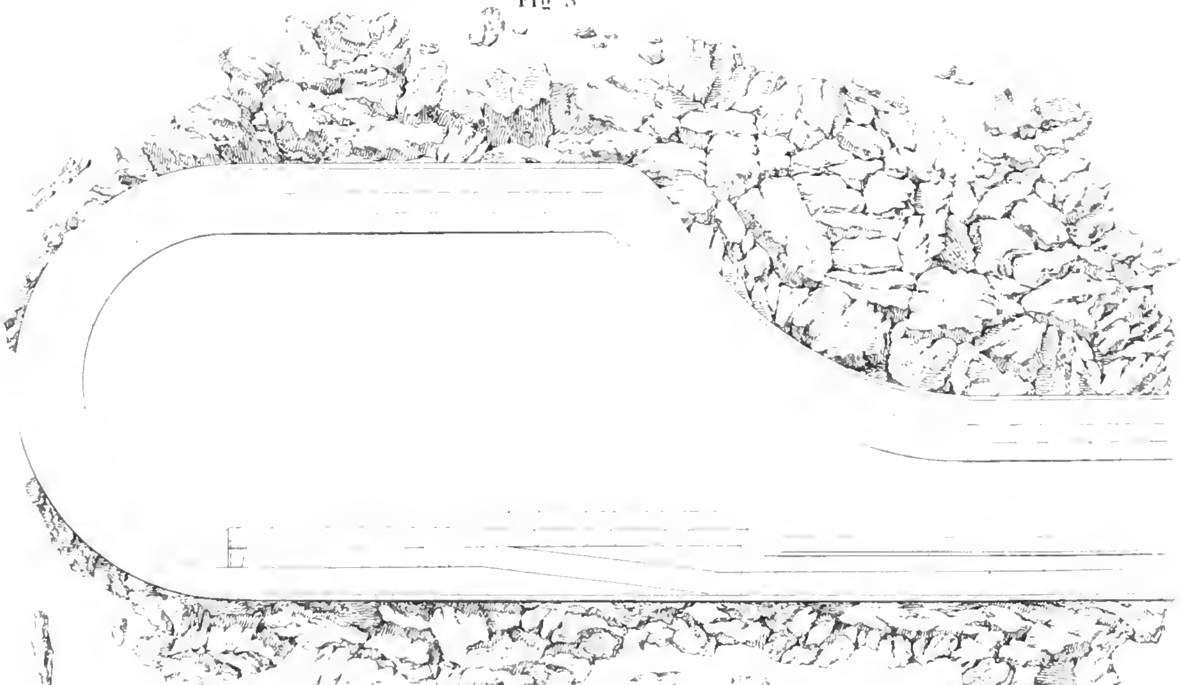
Plan of the Ports of St Malo and St Servan

Fig 1



Plan of the Port of St Malo

Fig 3



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ON THE CONSTRUCTION OF THE MOLE DES NOIRES, WHICH SHELTERS THE FRONT HARBOUR AND ENTRANCE OF THE GATES OF ST. MALO.

(WITH AN ENGRAVING, PLATE I.)

(Translated from the French of M. Girard de Caudemberg, Engineer-in-Chief of Roads and Bridges.)

THE Mole des Noires, forming part of the general plan of a floating basin which is to be common to St. Malo and St. Servan, has been in progress for the last two years, and is situated as pointed out in fig. 1, stretching from A to B. When the wind bows from S.W. to N.W., it is very much exposed to the action of the sea, and was consequently during its construction exposed to all the most unfavourable contingencies, by which works in direct contact with the sea are affected. For the purpose of opposing this action, a form has been given to the mole of an arc of a circle of 695 feet (212 met.) radius. The breadth of the top, including the parapet, is 19 feet (5·80 met.), which is strictly necessary for preserving a free passage for warping to the upper part, and for giving to the works the stability and resistance necessary to support the difference of pressure resulting from the maximum of the simultaneous elevation and depression of the waves on the two opposite faces. The dimensions of the mole are given in the section, fig. 2, in which are also shown the high and low water marks at spring and neap tides, which sufficiently justify the great elevation given to the work. This section also shows the great aqueduct or interior tunnel, and of the channels communicating with it. The aqueduct extends the whole length of the mole up to the head, and the upper and lower channels or pipes are made at every 65 feet distance. The lower inclined pipes end in a number of sluices, which are for the purpose of clearing away the silt in the front harbour.

The opinion of M. de Caudemberg was that this silt was little to be feared, but as the commissioners appointed by the Minister of Marine, insisted upon having an aqueduct which could work the sluices, in the front harbour, M. de Caudemberg suggested the plan now in execution. The aqueduct is 1978 feet (603 met.) in length and 7 feet 2 inches (2·20 met.) diameter, and is carried through the mass of the quay of the front harbour, crosses the gates of the inner harbour, and takes its rise in the floating basin. It is constructed throughout of an annular form. The pipes carrying the water to the sluices are inclined as represented in the section, and are of cast iron, their inner diameter is about 16 inches (0·40 met.), and the different parts which compose them are secured by a simple joint with resinous mastic. The upper part is terminated by a hemispherical cup 18 inches diameter, with a ball acting as a bomb valve. This valve is for the purpose of preventing the water introduced into the great aqueduct returning back again when the tide falls. Where however the sluices are intended to be worked the valve is lifted up, by means of a chain communicating with the upper surface of the quay. The water which flows from the aqueduct, through the inclined pipes, with the velocity of a column of water 24 feet high is carried through an opening 3 feet 3 inches broad, and of a mean height of 5 inches, so as to cause a stream of water to sweep away the silt. It should be observed that the large vertical pipes 19 inches (½ met.) diameter, serve for the evacuation of the air, and as manholes for cleansing and repairing the aqueduct. The parts marked *a b c* in fig. 2, are for the purpose of preventing the water at high tides from getting through the sluices, and causing an inverse pressure on the great aqueduct.

The engineer found considerable difficulty while constructing the mole, on account of the position of the great aqueduct, which as it was necessarily built upon a centering, would in case of wood being employed, have been soon blown up by the waves and destroyed, or at least have had the mortar forced out and the work to begin over again. To prevent this M. de Caudemberg directed his attention to the construction of a peculiar centering or shield. This centering was of cast iron, in moveable pieces, so that it should be readily managed in the progress of the works. On the outside was fixed an arm to break the power of the wave at the period of the shock, while at the same time the specific weight of the centering prevented it from being carried away. It is formed of panels weighing about a hundred weight each, so that they could be easily moved. The whole shield was 26 feet (8 met.) long, and divided into 16 rings.

M. De Caudemberg found that though by these means he broke the shock of the wave, that the works were still liable to suffer on account of the oscillations, particularly when the weather was rough, when masses of compressed air were forced into the great aqueduct, and so up the vertical manholes, causing spouts of water 30 or 40 feet high. These manholes however served greatly to modify the effects. As the best remedy, and one which was found effectual, the panels of the centering were covered with sheet iron, pierced with holes so as still further to break the violence of the shock.

As however the cast iron centering was in some degree an impediment to the works, whenever the state of the weather permitted it, a wooden shield was used also moveable, so that keeping 6 feet and a half of iron centering outside, about 50 feet of wood centering was used behind it. In this way 50 or 60 feet in length was got through in a day. To get over the difficulties and expense of transporting the materials to such a narrow space, small lighters, flat bottomed boats, and floating platforms were used, which were found to act well, although some inconvenience was felt in rough weather.

ON THE CONSTRUCTION OF A PIER IN THE RIVER AGLY.

(Translated from the French of M. Fauvelle, for the C. E. & A. Journal.)

M. FAUVELLE describes a process which is extensively used in Roussillon for constructing wells, and has also been applied by Mr. Brunel on a large scale in making the descending shafts of the Thames Tunnel. In most parts of Roussillon, and particularly on the shores of the sea, and near ponds, at a yard or two below the surface, a layer of quicksand is met with, which cannot be dug twenty inches deep without the sand falling and filling up the excavation. This consequently prevents the usual course of digging a well and building the brickwork afterwards, as it would cost more in timbering and framework than the whole well was worth. A stout circular oaken curb is therefore placed on the ground, the walls of the well are built several yards high upon it, and then from the inside the shifting soil is excavating so that the well is carried down to the required depth. M. Fauvelle had to build the pier of a bridge in the bed of the river Agly on a bed, which although it seemed quite dry, yet filtered a great quantity of water through pebbles and sand for yards thick, these again resting on a bed of clay. Being prevented from want of funds from using the ordinary means of getting rid of the water, M. Fauvelle availed himself of the Roussillonese plan. On the bank he placed an oaken frame or curb, and on this he built a well or circular tower of brick, 16 inches thick, 70 feet in circumference, and 13 feet high. This well was secured internally so as to resist the external and vertical pressure. Excavations were then begun in the interior of the well, but some injury was done to the walls at first by the workmen digging under the curb, and so causing an unequal descent and cracking of the bricks. The works were then limited to the interior of the well, and it gradually descended until it became necessary to use the dredge, by means of which, in about a fortnight, it was got down into the clay bed without any accident or injury to the walls. Nothing then remained but to fill up the interior so as to make a solid mass, which was done, without taking out the water, by throwing in concrete and stones, this work being secured to the walls by their being roughed with a chisel worked by a long iron bar: the whole was then well rammed down by two men so as to make a solid mass.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXII.

> "I must have liberty
> Withal, as large a charter as the wind,
> To blow on whom I please."

I. "ARCHITECTURE," says a writer in the last number of the Monthly Review, "is under a certain degree of restraint in every state of society. The nature of his materials, and the necessity of clipping down his conceptions to the views and wants of his employer, have accustomed the architect to act with apparent freedom, under circumstances which would wholly repress the ardour of the sculptor or the painter." This is rather oddly expressed, it being not very much unlike a contradiction in terms to attribute *freedom*, or apparent freedom, on the part of architects, to the *restraint* imposed upon their art. The writer does not seem to have taken the trouble of reading over what he had put down upon paper: but his meaning probably is, that the necessity of clipping down his conceptions, &c., has accustomed the architect to act with a servile compliance—a blind deference, to the wishes of his employers, and to do just as he is dictated to do, as if it were perfect matter of indifference to him: whereas a sculptor or painter is not quite so docile, but less patient of impertinent interference, and is apt to prove restive on such occasions, or else gets sulky, and pretends that he can do nothing if not allowed to have his own way. This, I conceive, would be much nearer the truth: for I do not understand how the architect can be said to act with apparent freedom, when, however willingly he may do so, making a virtue of necessity, he is evidently acting under control, and obliged to forego his own ideas, and maim his design by adopting those of other people.

II. There is, I suspect, no small share of hypocrisy, and not a little cowardice, also, with some addition of affectation into the bargain, in the praises heaped upon Palladio, because I have never yet either met with books, or been able to gather from any one in conversation, in which of his works the merits so liberally ascribed to him really consist. In speaking of him, every one seems to think it the safest policy to confine himself to general eulogy, without venturing at all into particulars. Nay, I have met with those who, after surrendering up to criticism, one by one, every production of his mentioned, have not had *courage* enough to confess that they were advocating a losing cause, but give themselves the airs of having the better of the argument, because, forsooth, Palladio had always been considered a very genius in architecture.

III. It is not without reason that Klenze has lately animadverted upon the plodding, barren, "machine-like," manner in which modern architects have applied themselves to Grecian architecture, without getting a step beyond two or three very obvious and stale ideas, which have now been hackneyed *ad nauseam*; as if its elements could not, by any possibility, be made to furnish fresh combinations or farther modifications as to detail, but every thing must be most according to precedent, at least, as far as columns alone are concerned, since, in regard to all the rest, a most convenient degree of latitude is considered quite allowable. It must not, however, be supposed that such "machine-like" system, one so utterly at variance with every principle of art, would be upheld in the manner it has been and continues to be, without some motive, although it is one which it would not do to let all the world know. The excessive reverence affected to be entertained by the *plodders* for antique examples, evidently does not proceed from an intelligent admiration of them: for it is plainly to be perceived that they have no influence whatever on their taste, and that if such admirers have studied them at all, it has been no otherwise than mechanically, without imbibing any of their spirit, without extracting from them any of their delicious flavour, after the fashion of that most praiseworthy little plagiarist, the bee, who steals their sweetness from flowers, but manufactures it into the still more luscious sweetness of honey. The dunces in the profession —and if any one chooses to include himself among the number, it is no fault of mine—the dunces, I say, are well aware that it is good policy in them to decry any modification of the antique, any thing like originality in the treatment of it, as most dangerous and mischievous innovation. Mischievous, indeed! no doubt—because were any sort of freedom in that respect to be allowed, were the system of copying and nothing but copying, to be exploded, as not exactly in character with what, justly or not, assumes to be something more than a mechanical science, even one of the fine arts,—the incompetence of many would at once become apparent, they being, as Wightwick has wickedly observed, "impotent to generate" even a single modification of what they now so *classically* follow as patterns; much more, then, to generate an idea of their own.

IV. It is by no means uncommon to hear people complain how exceedingly difficult it is to hit upon any new subject; nevertheless, there are both a good many hackneyed ones, which would admit of being treated with some degree of novelty, by blowing away the *learned* dust which now almost covers them, and freshening them up anew; and also a few others that have as yet not been touched upon at all, notwithstanding that they would furnish matter almost inexhaustible, and the opening of them would be like opening a virgin mine of unexplored wealth. It is odd that, until the other day, no one should have thought of treating the subject of porticoes as is done in the article in the Penny Cyclopædia, which, although unsatisfactory, because little more than a brief outline of it, is most valuable as a hint, and as pointing out what preceding writers had overlooked. I, myself, have at least half a dozen architectural subjects *in petto*, any one of which would supply matter for a volume, and some one of which I have long been expecting to see pounced upon and taken up by some less indolent or more enterprizing mortal. Nevertheless, they still all remain untouched, as safe and as snug as if they were buried within the innermost bowels of the earth, though really exposed where any one who has eyes to see with may behold them. There is plenty of fresh game to start, had but people noses to catch scent of it; for instance ————, and ————, and ————, I leave it to the reader's penetration to fill up the blanks,—all choice and fertile subjects as well as new, and only waiting for some one to pick them up; though I fancy that were they to stumble against them, most people would only stumble over them. It is undoubtedly very fine to be eternally talking about "Pericles," and such very *sublime* matters: yet that is not the way to discover any thing particularly novel. Those who walk abroad star-gazing, do not notice a purse of gold under their feet, or should they chance to tread upon it, only kick it away from them as a mere stone in their path.

V. The author of the "Palace of Architecture" has, I see, thought it necessary to assure the readers of Fraser's Magazine, that the article entitled "Wightwickism," in that periodical, was not a slashing cut-up of his book, as some of his own friends had conceived it to be, and were accordingly very indignant that such a violent attack upon it—nothing less than a downright demolisher—should have proceeded from that quarter; nor are they the only persons who have taken up that singular idea, for some sapient newspaper critic has described the paper alluded to as a complete settler for Wightwick! It is charitable, therefore, to suppose that both the reviewer alluded to, and those who have fallen into the same error, read no more than the first page or two of the article, otherwise they must be obtuse and obfuscated indeed, not to perceive its real drift. But there are people in the world so dully matter-of-fact, as to have no notion whatever of either irony or humour—people who take such a pleasantry as "A Lesson in Reviewing" for a serious attack upon Mr. William Cowper, the poet, fancying the writer to be in earnest when he gravely censures the bard's indelicacy, or rather offensive grossness, in venturing to use the term breeches, instead of employing the long-winded circumlocution resorted to by his biographer, Dr. Southey, in order to express, or rather insinuate the idea of, that vulgar article of male attire. And there are folks, it now appears, who either are, or affect to be, so perversely thick-headed as altogether to misconceive the writer's object in "Wightwickism." Nevertheless, with such exquisite stupidity staring us in the face, the present age is styled that of the March of Intellect—which "March," is, perhaps, the gravest and most notable mystification of all.

ON LIMES.

Researches on the several properties which may be communicated to cement stones and hydraulic limes, by imperfect burning. By M. N. Vicat.

(Translated for the C. E. and A. Journal.)

The principal object of this treatise is to illustrate several singular properties of imperfectly burned argilo-calcareous substances, and also some anomalous cases with regard to hydraulic limes. It is well known that hydraulic limes are converted into cements, when the proportion of clay is increased beyond a certain limit, in which transition may be recognised the nature of those compounds which participating in the properties, both of limes and cements, belong to neither class. Those compounds, which the author denominates *chaux limites*, or intermediate limes, on being completely burned, (that is, entirely deprived of carbonic acid), and treated like cements, become absolute cements, but if the cohesion be instantaneously acquired, it is lost in a few hours by a gradual extinction of the cementing properties, which instead of producing hydraulic lime, leave nothing but a kind of caput mortuum. Common hydraulic limestones have also peculiarities, becoming good cements, or giving products almost without value, according as they are burned to a greater or less degree.

The confusion resulting from such apparent inconsistencies, and the serious difficulties which had occurred in carrying on several important works, induced M. Vicat to investigate the subject, and to present the following observations as the result of his inquiries.

1st. All limestones containing 53 per cent. of clay should be rejected as extremely dangerous, and never allowed to be used in any operation, being incapable of forming any useful cement.

2nd. Perfect imitation of hydraulic limes by the mixture of slack lime and cement is impossible: as these mixtures are but slightly hydraulic, therefore to imitate natural hydraulic limes, the regular process must be followed.

3rd. Every argilo-calcareous substance, capable of producing a cement after being thoroughly burned, also gives a cement on being imperfectly burned, provided that the proportion of clay to free lime in the rough stone, does not exceed 273 per cent., or in other words, provided that there are less than 273 parts of clay for every hundred of lime. In acting upon this rule, super calcination is the only thing to be guarded against.

4th. Every argilo-calcareous substance, capable of producing an *intermediate* or hydraulic lime by being thoroughly burned, can on being imperfectly burned, produce a cement, or at least a product having all the properties of one, provided that the proportion of clay to free lime in the rough stone is not below 62 per cent., not only the imperfectly burned stones are no longer cements, but they may even fall into the class of weak hydraulic limes with a gradual extinction of power. As therefore no practical means exists of distinguishing at first sight imperfectly burned cements from those which are burned, and still less of regulating the degree of heat, so as to expel uniformly the required proportion of carbonic acid, it follows that by pulverising imperfectly burned cements, and mixing them indiscriminately with mortar as has been done on several works, the mortar instead of being improved, has had introduced into it an element of destruction.

Lastly. The manufacture of cement from intermediate limes is attended with serious difficulties, as it is impossible to find out which are perfectly burned. Every assay for the purpose of testing the quality of hydraulic lime, should be preceded by experiments on the quantity of carbonic acid contained in the lime, for if this acid is present in such a proportion as to show imperfectly burned non-cement, the assay will point out as bad an hydraulic lime, which thoroughly burned, would have the required qualities.

To the presence of imperfectly burned cements, M. Vicat attributes most of the injuries, splitting of joints, &c., visible in buildings, and which never occur when the lime is good. As the quickest and surest test M. Vicat recommends chemical analysis, but disapproves of the ordinary mode, for if the clay be separated from the carbonate by an acid and then treated with potass, a gelatinous silex is produced from those quartrose particles which do not enter into combination. He therefore recommends the immediate reduction of a few finely powdered grains into lime or cement; to make sure that no carbonic acid remains, and to dissolve the whole in an excess of hydrochlaric acid. The residue, not reduced, will give the quantity of uncombined clay which imbibes the hydraulicity of the lime. The rest of the assay may proceed in the usual way.

OPENING OF THE PORT OF FLEETWOOD-ON-WYRE TO NIGHT NAVIGATION.

This interesting and important event took place on the evening of the 1st of December. It must ever be interesting to behold the efforts of art founded on pure science, when supported by spirited funds, eminently successful. It must ever be appreciated as a vital achievement when a region, hitherto unapproachable by night and seldom by day in stormy weather or slanting winds, shall be pronounced and proved, not only accessible, but within the instant comprehension of the weather-driven mariner, even though he never saw the coast before. Such have resulted at Fleetwood-on-Wyre, under the plans and personal superintendence of Capt. Henry Mangles Denham, R.N., F.R.S., consulting marine surveyor, supported by the encouraging confidence of the board of directors, and unflinching appropriation of means. It is our pleasing task to record facts so honourable and gratulatory to all parties engaged. Here is a Company realising all that is due to energetic espousal of capabilities which might as heretofore, have laid useless to a nation, and unprofitable to enterprise, but for the exercise of perception and that moral courage which boldly traces in perspective reasonable results. An estuary hitherto (indeed 16 months ago) overlapped by spits on its seaward reach, precluding intercourse with its natural tidal basin and anchorage, now presents a straight course, of but 15 minutes run, between 20 fathoms Irish Sea water and the railway terminus, which is connected by 11 hour, journey with London. The full particulars of which are set forth and illustrated in Capt. Denham's work on the Mersey, Dee, and Wyre navigation. We, therefore, need only revert to it, and glance at the simple, but effective ceremony which locally marked the occasion of formally opening the Port. At sunset on the evening of the 1st December, the Chairman, Sir Hesketh Fleetwood, Bart., M.P., a party of 80 gentlemen, their Secretary, John Power, Esq., and last, but not least, some fair ladies, accompanied Captain Denham in a steamer to the offing. Passing the several buoys which mark the New Cut channel, for daylight and hazy weather guidance—at a proper period of darkness, when no vestige or clue to land, or haven entrance, could be traced, and no access to be hoped for until the next morning, a rocket was thrown by Capt. Denham, and instantly the lantern chambers of the new light-houses were unmasked. Three hearty cheers welcomed the lights on board, and three more with every hand open, greeted Captain Denham; whilst peals of cannon on shore called attention to the fact. The lights were then brought in line, the course shaped, and at a nine knot rate the party were, in fifteen minutes alongside the Railway wharf. The instant of clearing the New Cut was signalled by a shower of rockets from on board. Cheer after cheer was responded to on shore by guns, rockets, and cheers; whilst the bands sent forth our glorious national anthem and Rule Britannia. Truth and candour avowed itself where 'tis ever nurtured. One of the ladies exclaimed, to the delight of the gallant Captain,—"Why the process of coming into this port is so simple I could bring a vessel in." —*Railway Magazine.*

WHITELAW AND STIRRAT'S PATENT WATER MILL.

Fig. 1

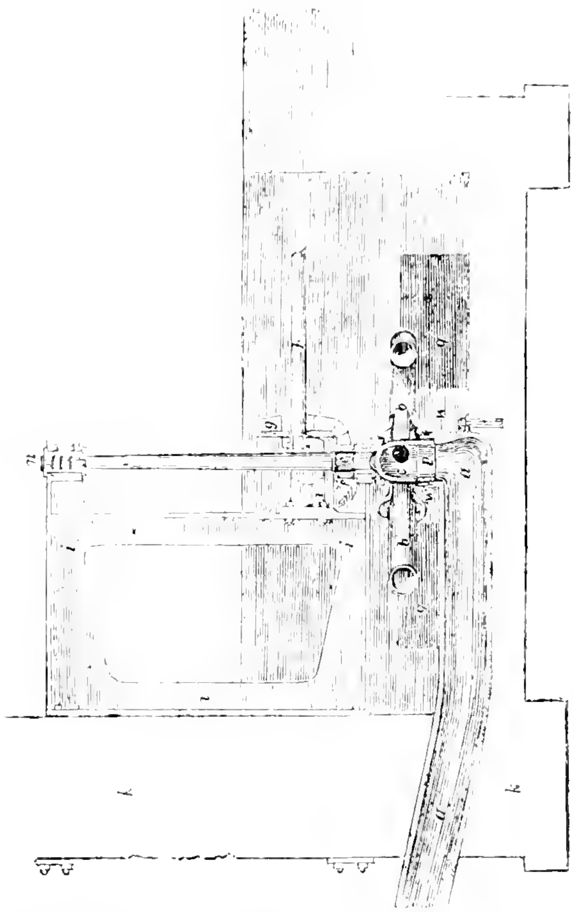
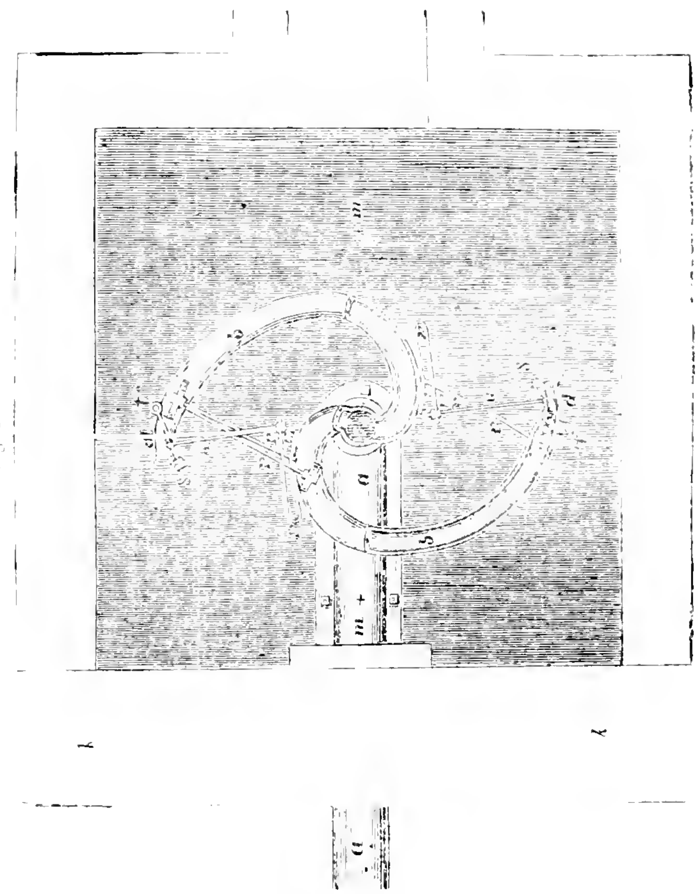


Fig. 1 is a side elevation of the new water-mill, in which figure some of the parts are drawn in section. Fig. 2 is a plan showing the arms and other parts of the machine. The main pipe *a a* carries the water which drives the machine into its arms, from a reservoir or any suitable place on a higher level than the arms: *b b* are the arms, which are hollow: the water passes into them at the centre part *c*, and escapes out at the jet-pipes *d d*: *e e* is the main or driving shaft of the machine, which is shown cast in one piece with the arms: *f* is a bevel pinion, and *g* a bevel wheel; by means of which wheel and pinion the rotary motion of the machine is communicated to the horizontal shaft *h*, which again communicates the power of the machine to any machinery which it may be intended to work: *i i* is a large bracket fixed to the wall or building *k k*; this bracket supports the shaft *e e*, while the bracket *l* carries one end of the shaft *h*. The perpendicular plane which passes through the parts represented in section in the elevation, Fig. 1, passes through the points *m m* in the plan, Fig. 2. The top journal or bearing *n* of the main shaft has a number of collars on it; for, if there were but one collar, it would require to be made larger in diameter than the collars shown in Fig. 1, in order to get a sufficient quantity of bearing surface; but if the diameter of a collar be increased, the friction will be greater, as then the rubbing surface is more distant from the centre of motion; so, if a sufficient quantity of bearing surface is obtained by a number of collars, there will be less friction than if only one is used to resist the pressure. *q q* are holes through which the water escapes from the basin under the arms into the tailrace after it has left the machine. As the arms have a rotary motion, and the pipe *a a* is fixed to the building under it, there must be means provided to prevent the escape of water at the place where the main-pipe meets the arms. A contrivance suitable for this purpose is shown in Fig. 1; it consists of a ring or projection round the underside of the aperture *c*, and of a part *p* turned cylindrical at the place where it fits into the pipe *a a*. A leather, similar to what is used in packing the large piston in a Bramah press, is inserted into the recess *o o*, turned inside of the top part of the pipe *a a*, in order to prevent the escape of water betwixt the pipe and the cylindrical part of *p*. It will now be clear that if the part *p*, and the ring on the underside of *c*, are accurately turned and ground upon each other at the place where they meet, the pressure of the water in the main pipe will act upon the under edge of *p*, and press it in contact with the projecting part round the aperture *c*, and in this way keep the joining of those parts water-tight. There is a flanch outside of *p*, with holes bored in it, to receive steadying-pins fixed to the top part of the pipe *a a*; these pins are seen in Fig. 1; they prevent the part *p* from revolving, and are fitted so as to allow *p* to rise or fall. There is another use for the flanch round *p*, which is this:—a little rope-yarn is wrapped betwixt it and the main pipe, to prevent the part *p* from sliding down whenever there is not a sufficient pressure of water in the main pipe to support it. The pipe *a a* is bored out to receive the part *p*, which is fitted so as that it will slide easily up or down in the bored part; *r r r r* are the stay-bolts which support the arms; *s s* are valves, and *s t s t* are levers which work upon the centres *t t*, and form a connexion of these centres with the valves. There is a lever on the top, and one on the bottom side of each valve. The rods *u u* form a connexion with the levers *s t s t*, and the springs *v v v v*, fixed to the arms. The end next the valve of each jet-pipe (see Fig. 2) is a circle drawn from *t* as a centre: and each valve is curved

Fig. 2



to fit and work correctly upon the end of its pipe. The levers *s t s t* are adjusted so that the valves *s s* will work without rubbing upon the ends of the jet-pipes, in order to get quit of the friction as much as possible; but it is not essential that the valves should be correctly water-tight. It will be clear, that if the machine revolves so fast as to make the united centrifugal forces of the valves *s s*, the rods *u u*, the levers *s t s t*, and the springs, greater than the weight that will bend the springs *v v v v* to the distance shown in Fig. 2, the valves will recede from the centre of the machine till the force of the springs gets sufficient to overcome the centrifugal force of the valves, &c. Therefore, the centrifugal force will cause the valves to cover the ends of the jet-pipes, and so allow less water to escape, and thus diminish the force of the water on the machine whenever it goes quicker than the proper speed. If the springs are considerably bent

* We are indebted for this description to a pamphlet by James Whitelaw, and for the use of the wood engravings to the Editor of the Mechanics' Magazine.

or strained when the valves are full open, a very small increase of the speed of the machine will cause the valves completely to cover the ends of the jet-pipes, and when the ends of these pipes are closed, the water can have no power to turn the machine. From this it will be clear, that the machine can be made so that, when it is doing very little work, it will not move at a much greater speed than it will when acting with its greatest power.

The new water-mill acts on a principle similar to that of the well-known Barker's mill; but the arms are bent and otherwise shaped, so as to allow the water to run from the centre to the extremity of the arms when they are in motion, in a straight line, or nearly so, and in this way the disadvantages of carrying the water round with the arms, as is the case in Barker's mill, are got rid of.

The curve of the arms is such as to allow the water to run from their centres out of the jet-pipes, without being carried round by the machine, when it is in motion at its best speed. On this account, the rotary motion of the arms will not give to the water a centrifugal force. So the forces which work the new water-mill are simply the force of reaction, and the weight of a column of water of the same height as that acting on the mill, having the area of its cross section equal to the sum of the cross-sectional area of each jet-pipe. When the machine is standing, the one of these forces is as great as the other; but when it revolves so quick that the centres of the jet-pipes move at the same speed as that of the water flowing from them, the force of reaction ceases, as then the water falls from the jet-pipes without any motion, in a horizontal direction, for the machine leaves the water as fast as the acting column can follow it. When the resistance to be overcome is as great as will balance the force caused by the weight of the water, there is still the force of reaction left to bring up the speed of the machine; and as the weight of the water remains the same, whether the machine is in motion or at rest, the force of reaction will carry up the speed till the centres of the jet-pipes revolve at a velocity the same as that of the water issuing from them before it ceases. Thus the machine, when its jet-pipes revolve at a speed as great as that of the water issuing from them, will give its maximum of effect, which maximum will be equal to the whole power of the water it uses; for, in the time a given weight of water is expended, in the same time the machine is able to raise as great a weight from the level of the centres of the jet-pipes to the level of the surface of the water in the lead. There is of course a small part of the power lost, most of which is that caused by the resistance which the water meets with in passing through the main pipe and the machine. This portion of the force is very inconsiderable, as will be shown in the next paragraph; and, by making a slight alteration on some parts of the machine, this small fraction of loss may be still further diminished.

A machine erected lately for Messrs. Neill, Fleming, and Reid, at their works, Shaws-water, Greenock, gives, when tested by the friction apparatus invented by M. Prony, 75 per cent. of the whole power of the water which works it. The power of the water is 79 horses, and the power of the machine is equal to that of 59·25 horses or 75 per cent. as now stated. Mr. Stirrat's water-mill of 2½ horses' power is the first that was made; it was tested in the same way as the above-mentioned machine, and the result of the experiment was equally favourable.

The following are some of the advantages which the hydraulic machine of Messrs. Whitelaw and Stirrat, has over an overshot water-wheel of the best construction. The new mill has a governing apparatus, which renders its motion as uniform as that of the best constructed steam-engine; when a part, or even the whole, of the machinery which it works, is thrown off at once, the variation in the speed is scarcely perceptible. The speed of the new machine is well suited for every purpose: generally speaking, it can be formed to make the required number of turns in a given time, and on this account, intermediate gearing is done away with. There is little wear and tear on the parts of the new mill, for its weight is perfectly balanced by that of the water, thus taking away almost all friction, and consequently wear, at the rubbing parts: five of these machines are already in operation, and not a workman has been employed in any way at either of them since they were first set a-going, although one has been in constant use for nearly two years. The new machine takes up remarkably little room. No very expensive building or other erection is needed for the fixing of the new water-mill, and the cost of the machine itself is very trifling in every case, and especially on a high fall, where an overshot wheel, as also the building and excavation required for it, become enormously expensive. On a fall of very great height, where to erect an ordinary water-wheel would be altogether out of the question, the new water-wheel may be employed to great advantage. The new machine may easily be made to rise or fall according as the water in the tail-race is high or low, and one form of it will work to very considerable advantage in tail-water. The best constructed overshot water-wheel will not, after the speed is brought up for ordinary purposes, give more than 70 per cent. of the whole power of the water which works it; and the new machine, as has already been shown, gives 75 per cent., and it can be formed to give even a greater portion of the power of the water than this.

SUPPLY OF WATER TO THE METROPOLIS.

It is always with much pleasure that we approach this question, interesting as it is not only to the profession, but also to the public at large, being one of those subjects on which both parties meet as on common ground. The supply of water to the population has always with the supply of food generally acquired great political importance, and the provision for it has called forth some of the greatest triumphs of engineering. It has been but too truly stated by Dr. Southwood Smith, in his able Reports on the Health of the Metropolis, that an insufficient or impure supply of water is one of the main causes of disease in all classes of the community, and the means of removing which are well known to be in existence.

The valuable report which we now lay before our readers, proves most clearly to every unbiassed mind that London may be supplied with pure water without having recourse either to the Thames, or to any other river. All rivers and open canals are infected in some degree with vegetable and animal matter, particularly after heavy rains—for instance, even the New River is the receptacle of the land drainage for many miles. The water-works which derive their supply from the Thames are all within the range of the tide, impregnated as it is with the drainage of the metropolis, and the large manufactories on its banks, and so must it always be. The works which stand the farthest up the river, those of the Grand Junction Company at the London end of Brentford, are within the immediate vicinity of large gas works, a soap manufactory, and the drainage of a brewery, and of one of the largest distilleries, without reckoning the drainage of the whole town.

To the Provisional Committee of the London and Westminster Water-Works, &c. &c.

Gentlemen—The insufficiency and badness of the present supply of water to the metropolis have long engaged the public attention; but although many endeavours have been made to establish it on a better basis, owing to causes which we must seek in the elements of the projects themselves, they have invariably failed.

As it appears, however, generally admitted, that something should be done, we are naturally led to inquire into the reasons of the want of success of former attempts, and by carefully avoiding these, and at the same time endeavouring to present an effective and practical remedy, we may still hope to deserve the public confidence. It will, therefore, be my endeavour to show, in the following report, that Nature has supplied us with the means of substituting a pure and unceasing flow of spring water for the outpourings of filthy drains, and that this can be done without encountering difficulties of any but an ordinary nature.

Nevertheless, before I proceed to do this, it may not be useless that I should briefly enumerate the various plans which have hitherto been suggested to attain this object; as this will at once prove how much time and attention, not only numerous private individuals, but even the legislature, have bestowed on the subject; and will also enable me to point out to you what appear to me to have been the causes of their rejection.

So far back as the year 1821, a committee of the House of Commons made a long report, in which they recommended that a bill should be passed to regulate the water companies, which had at that time caused much dissatisfaction, on account of the great increase, which a coalition enabled them to make, on their former rates. The inquiry, although it does not appear to have led to any positive result, nevertheless, called the attention of the public to various facts which were not previously generally known, and among others, to the very inferior quality of water which many of the companies supplied. We accordingly find, that in 1824, a highly respectable body of gentlemen held a meeting, to take into consideration a proposition of Mr. Philip Taylor's, to conduct the water of the Thames, by means of a subterraneous aqueduct, from a point near Richmond, to reservoirs at Kensal Green and Hampstead Heath.

In 1825, a company was formed to supply the metropolis with spring water, from beneath the London clay, a project which was again brought forward in 1835, and to which I shall have occasion, in a later period of this Report, to allude at some length.

But it was not until the spring of 1827 that in consequence of the publication of a pamphlet, entitled "The Dolphin," by Mr. Wright, the general mass of the inhabitants of London could be said to have been aroused to a sense of the paramount importance of a better supply of water to their houses, than that derived from some of the most foul portions of the river Thames. At [illegible] for so great a length of time, in public indignation [illegible] many instances of a meeting held in April 1827, which was attended by a most influential body of the nobility and residents of the West of London, resolutions of a very strong nature were passed, and a petition agreed to, praying for the appointment, by the Crown, of a commission to inquire into the present modes of supply, and their effect on the health of the population.

In compliance with this urgent demand, Dr. Roget, Mr. Brande, and Mr. Telford were named on the 12th July, 1827, to examine the allegations brought forward, which at once led to the suggestion of numerous remedies for an evil, which no one appeared ready to controvert.

Among these we find a Mr. Hipkins proposing to convey in an open conduit the water of the Thames from above Old Brentford; Dr. Harrison, from Isleworth, and Mr. James Mills, from Teddington; Mr. Martin, the artist, also sought to shew that the water of the river Colne might be brought in a canal from Denham, in the neighbourhood of Uxbridge, to London; and in addition to these various other proposals emanated from Messrs. Smart, Brown of Wakefield, Chambers, Jones, William Anderson, &c. &c.

None of these, however, were fully discussed by the commission, as the demand for their Report rendered it necessary that it should be given in long before they could well said to have terminated their labours.

The evidence they obtained enabled them, however, to decide "that the present state of the supply of water requires improvement, that the complaints respecting the quality are well founded, and that the water ought to be derived from other sources than those now resorted to."

In consequence of this report it was deemed necessary that a Select Committee of the House of Commons should be appointed to make further enquiries, and at the end of the session it appears to have fully agreed that the supply should be derived from a purer source than the present, in furtherance of which object it was recommended that Mr. Telford should be employed to make such surveys as would enable him to suggest a practicable plan of supplying every part of London with wholesome and pure water. After several years of protracted enquiry, Mr. Telford came to the conclusion that it would be desirable to bring the water from the river Verulam, on the north side of the Thames, and one of the branches of the Wandle, on the south, to London, to effect which so large an outlay was necessary, that he proposed it should be met by a parliamentary grant.

Another and numerous committee of the House of Commons again met to consider these plans, but its labours were unfortunately not terminated at the end of the session: the enquiry may therefore still be considered as remaining nearly in the same state in which it was left in the year 1834.

The plan of sinking Artesian wells to the sands of the plastic clay or chalk, has indeed, as I have already mentioned, been again mooted, but abandoned for causes to be hereafter detailed; and Mr. Telford's proposal of bringing the water of the Verulam to London has also been taken up, with various modifications, by Mr. Giles, who, however, did not succeed, I believe, in the preliminary step of finding capitalists willing to embark in the undertaking.

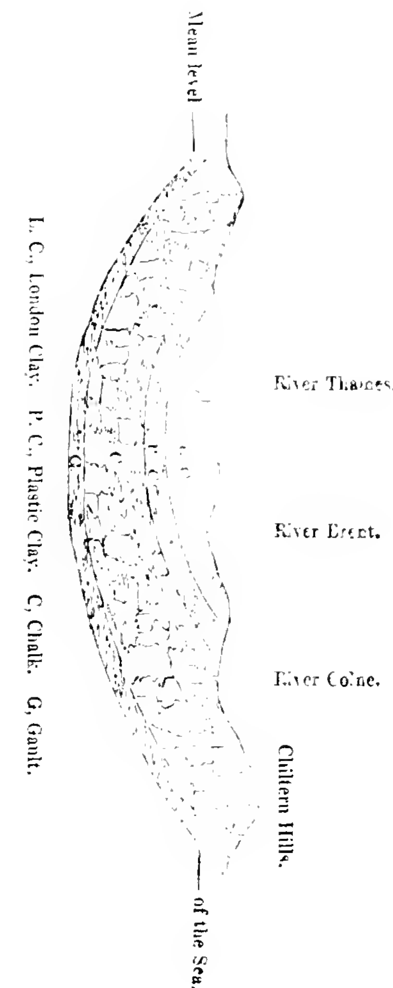
It will now, I think, be sufficiently established that the present mode of supplying London with water, has for a length of time, been any thing but satisfactory to the public; and if for some years past the subject has been allowed to rest, it has probably arisen more from a prevalent idea that the enquiry was in the hands of the legislature than from any real abatement of the grounds of complaint.

From various causes it would seem, however, that there is no intention on the part of tha government to prosecute the enquiry; and, indeed, this may in some degree be accounted for from the country being called upon, according to Mr. Telford's plan, to expend nearly £1,200,000 to carry that into effect which many have already doubtless perceived to be but a partial remedy for the evil.

It is indeed surprising, that with the exception of the proposal to obtain the water by perforating the London clay, every project, including Mr. Telford's, should have contemplated using the water of streams which are all subject to be affected by the surface drainage of a more or less extensive tract of country, and, consequently, only a very few degrees better than that already in use, whilst at the same time all the difficulties consequent on the injury to existing interests, as navigations, mills, &c. have to be encountered. Many, although they sought to remove the objection to using the water of the Thames in the immediate vicinity of London, continued to endeavour to derive their supply from a greater distance, where, although, certainly less liable to contamination, it might still be considered as the common sewer of many important towns on its banks, and the general drain into which much animal and vegetable matter must find its way, particularly after the scouring of the neighbouring country by every heavy fall of rain.

I do not, indeed, at all contest that the extraneous bodies, which pollute the water of rivers, are merely held in mechanical suspension, and that provided we get rid of these by allowing them to fall to the bottom, the Thames water may be looked upon as quite as pure as any other. But there appears to me one material objection to the method of removing the impurities by rest, which applies to all surface water, namely, that a considerable space of time is necessary to admit of their complete separation, and as this is also increased by the slightest agitation again diffusing the particles of the deposit through the water, the gradual accumulation of filth in the reservoirs, and the lapse of time requisite to render the water clear, must undoubtedly add to its unpleasant odour and flavour, or, in other words, to its tendency to become putrid. I therefore repeat, that it is scarcely to be wondered at, that the legislature should have delayed acting on Mr. Telford's plan, which combined these objections with a very large outlay, nor that a company should still have found grounds for proposing Artesian wells in preference to his suggestions. That this, however, was not to have been easily attained, appears partly proved by the fact, that this project was never brought to maturity, and the remarks I am now about to lay before you will also, I trust, confirm this view.

The group of strata, designated as the lower tertiary, or eocene, and consisting of two divisions, the upper called the London clay, and the lower composed of various coloured sands and argillaceous deposits, distinguished as the plastic clay, lying immediately upon the chalk formation, may in general terms be considered as a huge mass of clay resting upon a still more extensive



bed of chalk. The section which accompanies this report, and which, with slight modifications, is taken from Dr. Buckland's Bridgewater Treatise, will shew this clearly, and by inspecting it you will at once understand that the surface of country occupied by the clay, is surrounded on all sides by a belt of chalk, excepting to the east, where the German Ocean for some distance interrupts the continuity, and you will also perceive that this cretaceous circle is, generally speaking, higher in level than the deposit of clay which fills the centre of the basin.

It is almost needless that I should inform you, that of the water which descends as dew or rain upon the surface of the London clay, little, if any, can be considered as absorbed into the earth, and that whilst a part either again reascends into the atmosphere as vapour, or enters into the composition of animal and vegetable bodies, by far the greater portion flows off into the main drain of the district, the river Thames.

In this respect there is a most material difference from that portion of the surface where the chalk comes to light, divested of any covering which could intercept the passage of the moisture; being not only extremely porous but also full of fissures in every direction, a very rapid absorption takes place, and we accordingly find that there are but few streams carrying off the surplus surface water, and that these are insignificant, and, indeed, many of them dry during the greater part of the year. The rapidity with which the water finds its way into the bowels of the earth, also in a great measure, prevents evaporation, and we are therefore justified in assuming that the quantity which descends upon the surface of the chalk finds its way, with very slight diminution, into the fissures below. The lower beds of the cretaceous group, and the gault which immediately succeeds it, again present an impermeable stratum of clay, causing the water to accumulate through the lower regions of the more porous chalk. An enormous natural reservoir has thus been formed and the level up to which it may be considered as quite full of water is the lowest point where it can find a vent and overflow, therefore, as the chalk communicates under the coasts of Norfolk, Suffolk, and Essex with the ocean, this level, in the present case, may be considered to be the same as the mean height of the sea.

That there is, however, an extensive accumulation of water above this level will be obvious, when it is considered that the friction, which from the nature of the small fissures and pores must exist, will necessarily prevent the water from exerting rapidly its hydrostatic pressure, and as for this reason it cannot flow off with sufficient velocity, the higher parts of the chalk belt which surround the London clay being saturated, will allow of its escape to the surface wherever it can find a nearer and more ready vent than its subterranean one.

The greater or lesser facility, which from lines of fissures soft strata and pores, the water may encounter in flowing towards the centre of the basin, will also govern its surface, and cause it to assume an inclination, the angle of which will represent the friction, and in this manner we may readily account for the different levels, which often appear anomalous, at which the water will be found to stand in wells.

The foregoing remarks will now enable me, I think, to show that the proposal of perforating the tertiary clays for the purpose of obtaining the water for the general supply of the inhabitants of London, would not have been attended with the advantages which at first sight it would appear possessed of: it may indeed be urged that a reference to the section, shews us London situated nearly over the centre of the basin to which it gives its name, and that we may consequently infer, that wells sunk through eocene strata into the chalk, will derive their supply immediately from that portion where the greatest accumulation of water exists by my own shewing. But it will be found that this very circumstance throws a material difficulty in the way of any attempt to supply the inhabitants of the Metropolis from this source, and one which has been found frequently confirmed, when private individuals have sunk deep wells in London. The objection is, that whenever a large quantity is extracted, the wells in the vicinity, which derive their water from the same strata, are very sensibly affected: and, for this reason, that although a constant supply will always, as I have shown, find its way down, to take the place of whatever water we may pump away, this cannot flow in so quickly from the obstructions of the stratification, but that the level, for some distance round this focus, will be temporarily reduced. In other parts of the district, as will be readily understood, this would not be the case; or if so at least in an inferior degree, as a well would not here derive its share from every side of the basin at once, but only from that portion situated immediately above it. At Watford, for instance, a well would only be fed from the chalk which intervenes between that place and the great outcropping Chiltern ridge, and so in any other part of the belt. I may also here add, that the sheet of water in the deeper part of the chalk, can only be affected to an insensible degree by such a well, which at most would merely deprive it of the supply from a very trifling part of the great circle which every where else would remain untouched.

The company which had been based on the Artesian project, probably soon obtained facts which proved that their proposal could not be established without such interference with private interests, as they undoubtedly foresaw, would have great weight with the House of Commons; and they must also have taken into account the expense of forcing the requisite quantity of water to the elevation necessary for the high services, in addition to which, it must be borne in mind, that after perforating say two hundred feet of clay, the water under London by no means rises to the surface. As might have been readily foreseen, this idea was after some time, abandoned; and it is not surprising, that its originator, Mr. R. Paten, should have turned his attention to other endeavours.

The abundance of the springs which overflow into the Colne valley, above Watford, and the apparent purity of the water, had long attracted his attention, and now led him, in connexion with some other gentlemen, to make various experiments to ascertain whether a sufficient quantity for the demands of the Metropolis, could be obtained in that neighbourhood, at a small depth beneath the surface; and whether this might be effected without injuring the existing interests in the vicinity. When it was found that the result more than confirmed their most sanguine wishes, I was requested to examine whether the experiments were well grounded, and to advise as to the means of carrying the plan into effect.

I had for a length of time been acquainted with the various proposals which have been submitted to the public, and was aware of the objections which could with justice be urged against them. It was therefore not without pleasure that I undertook the examination of a plan, which I at once saw might be possessed of advantages, which were not before contemplated.

It will be my endeavour, in the remainder of this Report, to show how far the hope of obtaining the necessary quantity of water at Watford is well founded; to describe the experiments which have been made for the purpose of acquiring practical data, to explain the proposed method of procuring the water and conveying it to London; and lastly, to submit such remarks as will enable you, in my opinion, to present the project before parliament with a confident reliance that it cannot but deserve its attention and support.

As I have already described at some length the geological features of the country surrounding London, I am not called upon to add much to my former explanation on this head, and shall confine myself here to stating, that as regards the more immediate object now in view, we may look upon the Colne valley as marking in a great part of its length, on the one side the escarpment caused by the outcrop of the plastic clay, whilst on the other, the country rises gradually to the north-western boundary of the chalk strata, the Chiltern Ridge.

An attempt to fix positive quantities, by any line of argument, is naturally attended with considerable difficulty; nevertheless, the following considerations will give some idea of the volume of water that can be derived from the chalk of the Colne valley.

The surface of country which has its drainage into the Verulam and Colne above Watford may be taken at $113\frac{1}{2}$ square miles. If, then, we assume that the annual fall of rain amounts to twenty inches, which you will find a low average, the result will be $14\frac{1}{2}$ millions of cubic feet of water per twenty-four hours, falling on the surface. Of this quantity, Mr. Telford found that the Colne carried off at Watford, thirty cubic feet per second, or about $2\frac{1}{2}$ millions per twenty-four hours: as this was however in a dry season, it will be safer to assume Dr. Thompson's calculations, with respect to the annual quantity of water flowing off by streams and springs, which he was led to fix at four inches, and this would give us for the area drained by the Colne, not quite three millions per day.

There remain then $11\frac{1}{2}$ millions of cubic feet per twenty-four hours, either to be again evaporated, or to find their way into the earth. In an earlier part of this Report, you will remember that I showed that the porous nature of the soil, in a chalk district, prevents the evaporation to a great extent; nevertheless, if we assume that with the portion which enters into animal and vegetable life, one-third of the entire quantity falling, disappears in this manner, we still shall have upwards of $6\frac{1}{2}$ millions of cubic feet, or 42 millions of gallons per twenty-four hours, supplying the sheet of water under that portion of the chalk surface.

Mr. Telford's examination of the body of water flowing off by the Colne river, having been made at a period of unusual drought, when the surface water might be considered to have nearly disappeared, we shall, I think, be correct in assuming that two millions at least of the quantity he measured, had issued from springs. In order therefore to represent the total subterranean flow, we should add these two millions to the former $6\frac{1}{2}$. These indeed would form no part of the supply to the deep, but would designate that supply which has been already explained, cannot find its way to the lower depths, owing to friction, and other impediments, and therefore seeks a readier vent at a higher level.

It was important that this should be set in its proper light, as the evident inference we may draw is, that we cannot, by pumping from a lower level, a quantity small in comparison to the accumulation of water, produce any visible effect upon the springs which feed the Colne.

I am quite confident that my views as regards the manner in which the water finds its way into the strata of the chalk, will not for a moment be called in doubt by any scientific person, but that which may by such a one be considered in the light of a received axiom, and proved by numerous corresponding facts bearing thereon, with which he will be already acquainted, will require more lengthened demonstration to the general public, with whom an appeal to experience will have far greater weight than any abstract reasoning. To these then the experiments which have been made, will afford far more conviction than any argument however well founded.

The alluvial bed, which covers the bottom of the Colne valley, rather exceeds twenty feet in thickness, after which we reach the chalk; proceeding about five feet lower, abundant springs of water are encountered, which increase in magnitude and force as we continue to descend.

It was therefore in the first place necessary to ascertain that these did not derive their supply directly from the river, which, had it been the case, would have affected the various mills in the vicinity; and it was also desirable to have direct proof of the quantity which might be calculated on being obtained. In order to obtain positive evidence on both these points, a well was sunk in Bushey Hall meadows, near the Colne, to a depth of about 34 feet. Two small steam engines were then set up temporarily, for the purpose of working four pumps, of which two were 13 inches in diameter, with a length of stroke of 20 inches, and the others were $13\frac{1}{2}$ inches in diameter, with a 36 inch stroke. One of the engines might be calculated to produce from 27 to 30 strokes of the smaller pumps per minute, the other between 17 and 20 strokes of the larger pumps. The water of the well was now repeatedly pumped out, as low as the power of the engines admitted, and the height of the Colne at those times carefully noted, and it soon became obvious that the height of the springs could in no degree be said to affect the level of the river, thus shewing that all direct communication between the two might be considered as cut off by a bed of puddle or clay. The next object of enquiry was as to the supply which a well might be expected to yield, and the result of a careful experiment, made under my direction, and confirming those previously conducted by Mr. Paten, satisfied me that after the water had for 24 hours been kept at the lowest level to which the power of the pumps would reduce it, (about 26 feet below its surface when undisturbed,) it rose in the well with a velocity equal to 2·02 feet per second, thus yielding 174,590 cubic feet, or 1,091,000 gallons per 24 hours. As this was obtained in a

... the bottom of which was only 12 feet 6 inches diameter, and as direct proof had been obtained by borings, that below the 34 feet reached in the well there was a constant recurrence of large springs, giving evidence that the water rapidly increased with the depth, which when 80 feet were obtained, became so prodigiously plentiful as to set all temporary means of overcoming it at defiance, and precluded all possibility of having recourse to it for the mere purposes of an experiment, I thought it quite unnecessary to seek further proof that a sufficient supply for all requisite purposes might with facility be obtained.

It would be premature to give, in the present stage of the proceedings, a detailed account of the arrangements I propose making, for augmenting the quantity to an adequate extent, and it may be sufficient to state here *that I have not the slightest doubt*, that by sinking a deep well, and extending tunnels, or drifts in the proper direction from its bottom, *the necessary supply will be fully accomplished.*

Being also convinced that the water filtering through the chalk might be considered as entirely divested of all impurities, held in mechanical suspension, of which, indeed, there was abundant ocular demonstration, (as it was so beautifully transparent as to admit of the bottom of the well being seen when the water was upwards of thirty feet deep,) I at once turned my attention to the best means of conveying it to London.

The principal difficulty which intervenes is the ridge formed by the escarpment at the outcrop of the plastic and London clays, which Mr. Telford in his proposal to bring the water of the Verulam stream to London, had contemplated perforating by a tunnel three and a-half miles in length. My connexion with the London and Birmingham Railway has placed me in possession of facts which convince me that at the level at which Mr. Telford would have traversed some of the beds of the chalk, and the whole of the plastic clay, he would have met with very great difficulty, in consequence of water. For this reason, I propose, on leaving the Colne valley, that before entering the ridge which separates it from the district draining into the Brent, the water should be forced to a height of fifty feet above its original level, at which elevation we get rid of the difficulties of the plastic clay, as we only traverse quite its upper extremity, where no water has yet accumulated. The length of the tunnel is also considerably reduced.

I have preferred adopting a Line which is materially shorter than Mr. Telford's, as, with the exception of the said tunnel 2½ miles in length, no difficulty of any kind is encountered. Immediately on the water re-issuing into the open air on the side of Brockley Hill, I propose forming a reservoir to contain three days' supply of water, with a sufficient head to admit of a main being laid hence, and conveyed, (in order to avoid all opposition from landowners,) from the town of Edgware to Oxford Street, along the side of the road itself; thereby also facilitating the laying of the main, and rendering all the works of any magnitude, as earthwork, aqueducts, &c. unnecessary. The level of the reservoir will lastly be such, that the highest service can be given; and indeed a part of the town, which none of the present companies can supply, will be included within its range.

I trust I have now said enough to convince an unbiassed person that there exists no difficulty, both in obtaining a supply of good water from the Springs of the Chalk, near Watford, and in conveying it thence to London. I must, however, impress you here with the necessity of enforcing my arguments, with as numerous a body of facts as can be collected: and I would therefore recommend that, previously to the meeting of Parliament, I should be authorised to collect such information respecting the quantity, nature and quality of the wells in every part of the chalk circle which surrounds London, as will bear practically on the subject. This might then be embodied in a second part or appendix to this Report, to be submitted to those who, being unacquainted with geological phenomena, may consequently hesitate in adopting views which others, already scientifically acquainted with the subject, will not for a moment call in doubt.

In concluding, I may be allowed to cast a retrospective glance at the advantages held out by the project I have been called upon to examine. These then consist in its being proposed to use spring water, already naturally filtered, in preference to that which has drained a portion of the earth's surface; in making use of that enormous reservoir which nature has supplied us with in the Chalk, and effecting this at a spot where no existing interests can be injured: and in the selection of such a situation as enables us to convey the supply to London with facility and economy, and at a sufficient elevation to satisfy the demands of even the highest part of the metropolis.

I have the honour to be, Gentlemen,
Your obedient servant,
Robert Stephenson.

London, Dec. 16, 1840.

ASSISTANT ENGINES UP INCLINED PLANES.

[At the last Meeting of the London and Croydon Railway, the following reports were read, respecting the use of assistant engines up inclined planes.]

To the Directors of the London and Croydon Railway.

Gentlemen.—According to your instructions, I have written to the Liverpool and Manchester, the Grand Junction, and the London and Birmingham Railways, to ascertain whether the practice of assisting trains up inclined planes by an engine at the rear exists on those lines, and whether it has ever been found to be attended with danger or inconvenience.—I learn that on the Liverpool and Manchester Railway the system is in *daily use*, and that it has never been found to be attended with dangerous consequences: on the contrary, it is considered *safer* with a long train to assist up an inclined plane by an engine behind the train rather than in front.—On the Grand Junction Railway, the assistant engine is behind in assisting up short and steep inclines; but elsewhere the assistant engine, if required for heavy or late trains, takes the lead. Hitherto, neither inconvenience nor danger has resulted from the practice, which is prohibited *except* on inclined planes.—On the London and Birmingham Railway, pushing a train on the line is only allowed in cases where the power cannot be applied in any other way. Your obedient servant,

Charles H. Gregory, Resident Engineer.

December 8th, 1840.

To the Directors of the London and Croydon Railway.

Gentlemen.—According to your instructions, I have this day tried an experiment, in the presence of the Chairman, Deputy-Chairman, and Mr. Baines, for the purpose of determining practically the effect of the assistant engine on the inclined plane at New Cross, and the actual amount of danger to be anticipated from the sustained pressure of the assistant engine in the case of any sudden stoppage of the train before it. With this view, a train was made up of five loaded coal-wagons of a gross weight of 30¾ tons (which is about equal to an ordinary passenger train). The *Croydon* engine was placed at the head of this train, and drew it up the inclined plane, with the *Hercules* engine assisting at the rear.—On the train acquiring a velocity of 22½ miles per hour, the steam of the leading engine was suddenly shut off. The effect was instantaneously felt in the assistant engine, on which the whole weight of the train seemed thrown back, causing a strong re-action, which reduced the velocity of the train to 15 miles per hour, the steam being still acting with full force in the assistant engine. The order was then given to stop the assistant engine: the steam was shut off, and the brake screwed down, when the engine instantly separated from the train, and stopped in less than its own length.—The same train was then taken up by the leading engine alone, and on attaining the same speed of 22½ miles per hour, the steam was shut off. The velocity of the train was reduced for the first furlong from 22½ to 12 or 15 miles per hour, being nearly the same as in the previous case, when the assistant engine was acting behind. The engine and train stopped in a distance of 7-32nds of a mile, without the use of the brake.—The practical inference from this experiment is valuable, as showing that there is a great deal of unnecessary alarm existing as to the supposed danger of the assistant engine on the inclined plane.—First. Any stoppage of the train is instantly felt on the assistant engine, which may be stopped before any serious result can arise from its overrunning the train.—Secondly. The effect of any sudden stoppage of the train is to cause such a sudden re-action on the assistant engine that for the first furlong afterwards it appears to communicate scarcely any impulse to the train, the velocity of the train after the steam is shut off in the leading engine being nearly the same, with or without the action of the assistant engine.—Thirdly. The retarding effect of the inclined plane is so great that the least obstruction would be sufficient to stop the train in a very short distance, even when the assistant engine is acting with full force. Your most obedient servant,

Charles Hutton Gregory, Resident Engineer.

It was stated at the meeting that Mr. M. Ricardo, of Brighton, had constructed a model of a machine which appeared likely to be of use not only in such cases as were now more particularly referred to, but in cases of collision.—The model was here exhibited. It consisted of a strong frame-work, somewhat similar to the frame-work of a goods-truck, the area being filled with powerful springs, so arranged as to collapse upon the application of a strong impinging force, the effect of the blow being thus of course broken.—A small experimental railway has been constructed at New Cross station, for the purpose of testing, as far as a model could test, the efficiency of the invention.

THE ORIENTAL STEAMER.

Abstract of the Log of the Peninsular and Oriental Steam Navigation Company's Steamer Oriental, John Say, Commander, on her second voyage from England to Alexandria and back.

		Distance in Miles.	Hours under Steam. H.	M.	Remarks.
Out.	Falmouth to Gibraltar .	1,069	143	25	Tremendous gales during three days.
	Gibraltar to Malta	989	91	0	Fine weather, average speed. 11 knots per hour.
	Malta to Alexandria	827	83	15	Fair weather.
Home.	Alexandria to Malta ..	875	93	30	Heavy head sea.
	Malta to Gibraltar..	981	103	0	Fair weather.
	Gibraltar to Falmouth .	1,074	118	5	Heavy gales during three days.

Steamed, out, 2,885 miles, in 317 hours 40 minutes.
— home, 2,880 miles, in 314 hours 35 minutes.

Total distance, 5,765 miles, in 632 hours 15 minutes.

Lowest average rate of speed from Falmouth to Gibraltar, violent gales, 7½ knots per hours. Highest average rate of speed, 11 knots per hour.

IMPROVEMENT ON ECCENTRIC RODS.

Sir—A plan has long been desired for working the sliding valves of a locomotive engine with two fixed eccentrics, (that is one to each cylinder) so as to give the lead correctly when the motion of the engine is reversed, that is to say, when the engine is working either way. There have long since been locomotive engines constructed with only two eccentrics, and so as to give the required lead to the valves, when working in either direction: but these eccentrics used to work loose upon the shaft, and when the motion of the engine was required to be changed, their situations were altered, by means of levers and catches. But before these catches could get to their proper places, the shaft was obliged to be turned, nearly half way round at least, therefore, each engine was furnished with a set of rods and levers to enable the engine man to work each valve by hand, until the shaft came to the proper place for the catches to go together. This plan, in consequence of the tediousness in reversing the motion, its being so very liable to get out of repair, and other objections, has nearly fallen into disuse.

The plan now almost universally adopted, consists of four, all of which are firmly fixed to the shaft. These eccentrics are so arranged that two of them work the valves when the engine is going in the forward direction, and the other two work the valves when the engine is going in the backward direction. The four eccentric rods are all connected to one main lever, namely, the reversing lever, and by this lever two of the eccentric rod-ends may be attached to, at the same time the other two will be detached from, the levers which work the valves. With this arrangement the starting, and the reversing, of the engine are so simple as to be performed by the greatest novice; while with the former, the engine man requires considerable practice before he can get properly into the way of starting and reversing.

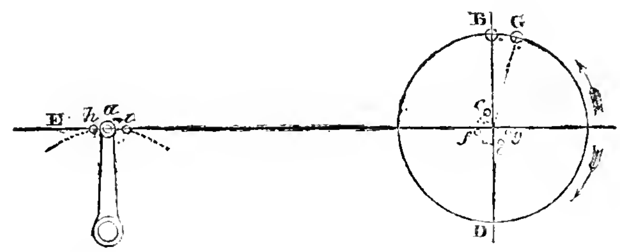
A plan for reversing the motion of the engine with greater ease, and for giving the lead to the valves with greater accuracy than that with four eccentrics, can hardly be desired; but it has long been the study of many ingenious persons to contrive a method from which they may obtain exactly the same result with *two fixed* eccentrics. This subject has, to my knowledge, been the cause of many experiments, some of which have by accident arrived pretty near to the point of correctness; but on their being performed upon a larger scale, in consequence of the persons engaged in them not being thoroughly acquainted with their ruling principles, they were deemed incorrect. There are those who have studied this subject so minutely, and made so many unsuccessful experiments, as to at last conclude it impossible to obtain this result in the manner alluded to. I have seen several ingenious diagrams intended to prove the impossibility, and I have even known attempts made to prove it impossible by geometrical demonstration.

I think it needless for me to enter into the details of the valve work, but, however, I will give you a short description of the method of setting the four eccentrics, which will refresh your memory with their principles, and at the same time perhaps, serve for as good proof of the plan I am about to describe, as can readily be given.

As the eccentrics, and all the other parts of the valve work, belonging to the one cylinder, are generally the same as, but quite independant of, those belonging to the other cylinder. And as each pair of eccentrics require to be set at exactly the same angle with their respective cranks, I think it will render the explanation much plainer, to only take into consideration the two eccentrics belonging to one cylinder, namely, one for the forward, and the other for the backward motion.

Suppose A B C D, fig. 1, to be a circle described by the crank, *a*, the lever to which the eccentric rods are to be attached, E C, a line drawn through the centres of the cylinder, end of the lever, and the crank axle, and B D another line also drawn through the centre of the crank axle, but perpendicular to E C. Suppose it to be at C. Now, when the crank is in this situation, the piston will, of course, be at the end of the cylinder; and the lead is generally considered as the distance the valve has moved from the middle of its stroke, or as the distance it is open, when the piston is in this situation. To give this lead, when the engine is working in the direction shown by the arrow F, the eccentric must be set about *c*; and the perpendicular distance from the line B D to *c*, is the quantity of lead in the eccentric. Now, when the rod belonging to *c*, namely, the eccentric rod, is attached to *a*, the valve will have the lead for working the engine in the direction shown by F, and it will continue to open until the crank arrives at G. But if the crank be turned in the direction shown by H, the eccentric will cause the valve to move in the wrong direction, and, consequently, allow the steam to act contrary to the motion of the piston; therefore, another eccentric *e*, is furnished, which is set at exactly the same angle with the crank as *c*, but on the opposite side. Both of the eccentric rod ends are connected with the reversing lever, as I have before observed, by which they may be detached from, and attached to the lever *a*, at pleasure. It will be seen, by a little attention to the figure, that the changing of the eccentric rods, when the crank is at C, will produce no alteration in the position of the valve, neither is it necessary it should, because the piston is then at the end of its stroke, and, although the crank be required to turn in the other direction, the steam will still be required to act upon the same side of the piston.

Fig. 1.



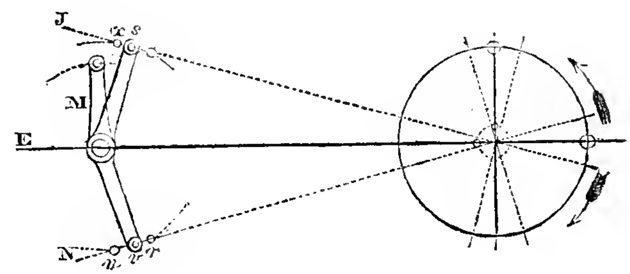


Fig. 2.

Let us now suppose the crank to be at B, the eccentrics will now be at *f*, *g*, and the piston about the middle of the cylinder. When the engine is intended to work in the direction of F, the rod belonging to *f*, must be attached to the lever, which will cause it to stand at *h*, and consequently the valve will be wide open, with the exception of the little difference caused by the lead. To reverse the motion, that is to say, to set the valve for working the engine in the other direction, the valve must be made to slide so as to open to the same extent, to allow the steam to act upon the contrary side of the piston. This is accomplished by the reversing lever, which detaches the rod belonging *f*, and attaches that belonging to *g*, which, by means of its forked end, draws the lever from *h* to *i*, and consequently causes the steam to act on the other side of, and force back, the piston.

By a little attention it may be seen that, while the crank is in any point of its revolution, the changing of the eccentric rods will produce that alteration, in the position of the valve, required to reverse the motion of the engine; therefore, I think the two points, in which we have supposed the crank, will be sufficient to explain the manner in which the lead is effected, and the motion reversed by the two fixed eccentrics to each valve.

I shall now proceed to explain the principles of a plan for giving the lead to the valves, and reversing the motion of a locomotive engine, with two fixed eccentrics, instead of four. In the following explanation, for the same reason as in the foregoing, I shall only speak of the valve, &c., belonging to one cylinder.

Suppose (as in fig. 1,) the circle A B C D, fig. 2, to be described by the crank, E C, a line drawn through the centres of the cylinder, and crank axle, and B D to be drawn perpendicular to E C. Suppose the crank to be at C, and the eccentric at *e*. After having determined the quantity of lead to be given by the eccentric, draw the lines F G, and H I, at the same angles with the crank, as you would set the eccentrics in fig. 1, to the same quantity of lead. Then draw the line J K, perpendicular to H I, and that end of the lever to which the eccentric rod is attached when the engine is working in the direction of L, must come in this line; supposing the valve to be worked from the lever M. By a little attention it will be perceived that, by setting the end of the lever in this situation, the valve will have the same quantity of lead, as it would if the lever and eccentric were set as in fig. 1. To cause the engine to be right for working in the contrary direction, no alteration is necessary in the situation of the valve; still it would not do to let the eccentric rod remain attached to *s*, therefore, I introduce another lever *v*, the end of which comes into the line N O, which is drawn perpendicular to F G, and, by means of the reversing lever, I detach the eccentric rod from *s*, and attach it to *v*, which will still allow the valve to have the lead, and also cause it to move in the proper direction, when the engine is working in the direction of P.

Let us now turn the crank to B. The eccentric will now stand at x. To cause the piston to work the crank in the direction of L, the eccentric rod end must be attached to the lever s, as before, which will cause it to stand at x, and consequently cause the valve to be wide open, with the exception of the little variation caused by the lead, as I spoke of in fig. 1. To reverse the motion, that is, to cause the crank to turn in the direction of P, I remove the eccentric rod end from x to r, and by this means (the eccentric rod end being properly formed) the lever will be drawn from r to n, consequently the valve will receive the same change as it did in fig. 1, by changing the eccentric rods, when the crank was at B.

By setting the cranks, in figs. 1 and 2, in any two corresponding points of their revolutions, it will be found that, when the eccentric rod in fig. 2, is attached to the lever s, the valve will be in the same situation as that of fig. 1, when the rod belonging to **c** is attached to the lever a. And it will also be found that the changing of the two eccentric rods in fig. 1, will effect the same change in the situation of the valve as the removing of the eccentric rod in fig. 2, from the one end to the other. Hence it is evident that one eccentric, with the two levers, arranged in the manner described, will produce the same effect, in every respect, upon the valve, as is now produced with the two eccentrics.

The distance s r, fig. 2, will depend upon the length of the eccentric rod, and the quantity of lead in the eccentric. If the eccentric be required to give a greater quantity of lead than common, it will perhaps be advisable to use two bell crank levers instead. But these particulars are of little importance, the principal object to be attended to is to set the ends of these two levers in the proper places.

I am afraid I am trespassing too far upon your pages, therefore I will conclude with a short explanation of a little deviation in this latter arrangement from the former, which, before, I did not think worthy of notice. When the crank is at C, fig. 1, either of the eccentric rods may be attached to the lever a, without moving it. But in fig. 2, when the crank is in that same position, it will be found that the eccentric rod cannot be removed from s to r, without making a little alteration in the levers. It would be a waste of time to enter into a minute explanation of this little alteration, which is caused by the vibration of that end of the eccentric rod which is in connection with the eccentric; upon the same principles as the piston is caused to be in the middle of the cylinder when the crank is at B.

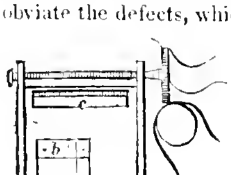
I remain, Sir, your's, very respectfully,

JOHN CHARLES PEARCE.

Leeds, Nov. 9, 1840.

IMPROVEMENT OF THE HYPSOMETER.

SIR—The ingenious little instrument for taking altitudes, invented by Mr. Sang and described in your last number, appears to me greatly deficient in one particular, and that is in the means of obtaining a level base line on which to conduct operations; the absence of this quality, indeed, renders it almost useless on uneven ground, and should the base be extended over a space of 80 or 100 feet or yards, the difficulty greatly increases; in this case, to trust to the eye for obtaining a level, would be out of the question; one might as well guess the altitude at once, as a quicker and equally correct method of arriving at the desired result; the instrument, therefore, if used alone, is rather contracted in its sphere of usefulness, an additional observation with a spirit level being necessary to obtain a near approach to truth. In saying this, my intention is not in any way to detract from the merits of Mr. Sang's invention; on the contrary, I confess myself much taken with it, and on that account have been turning over the scanty resources of a cranium somewhat obtuse, in hopes of finding something that might obviate the defects, which appear as such, in my humble opinion.



I would propose, therefore, the addition of a small milled-headed steel bar, an isosceles triangle in section, on which the instrument should be suspended; balancing itself thus, a base line will be obtained constant in its level; a cross wire over the aperture b will be necessary to complete the line of collimation. By these simple additions, altitudes may be taken with much greater precision, and the instrument will also acquire the properties of a level, sufficiently accurate for the purposes of gardening, for draining, or for levelling banks, and may be used generally except where great mathematical nicety is required.

Should you consider this modification, which springs from a dull man's brain, worthy a place in your Journal, it might, by chance, be turned to good account by some of your more intelligent readers.

Liverpool, AZIMUTH.

December 9th, 1840.

REVIEWS.

Companion to the Almanac for 1841. Knight and Co.

WE are requested to explain in our notice of the present volume of the "*Companion*," a most singularly unlucky and vexatious accident which has befallen pages 245 and 6, owing to the hurry with which the sheet containing them was made up for press, nor was the mistake discovered till it was too late to correct it by a cancel, the larger number of copies having previously been disposed of. Those of our readers, therefore, who may have happened to have already perused the architectural section, must have felt completely mystified by the descriptions of the Reform Club-house and the Corn Exchange, for they are so strangely intermixed and shuffled together, that it is utterly impossible to understand either as now put together by the printer, who has clapped down the saloon of the Club-house in Mark Lane, and *vice versa* put the newly modelled area of the old Corn Exchange into Mr. Barry's building in Pall Mall—which, it seems has been improved by Mr. Morris and decorated by Bielefeld. Perhaps this last rather startling piece of information may excite the architectural reader's suspicion, and satisfy him that there must be some mistake, although he may probably not be able entirely to unravel it,—or even if he can do so, to account for it—how by any possibility it could have occurred. In a monthly publication such a blunder would have been of much less consequence, because there the opportunity of rectifying it would have soon occurred, whereas a twelvemonth must elapse before the readers generally of the "*Companion*" can be satisfied that the architectural critic was not actually *muzzy* when he made his remarks on the two buildings in question.

The best way of correcting the mistakes will be to quote the passages where they occur. Speaking of the Reform Club-house he says: "We had imagined that the two smaller divisions both in the coffee-room and the drawing-room above it, would be separated from the other compartments into which those rooms are divided, by screens of —— columns, instead of which we now find that there are only attached columns at the angles of the projecting piers which form the breaks on the sides of those rooms, &c." Thus it will be seen that the latter portion after the —— in our quotation, and the rest of the article should be transposed from page 246 to the preceding one, and be connected with the line ending with "screens of." Which being done, the other blunder rectifies itself, it becoming obvious that the remainder of page 245, line 13 from bottom, belongs to the account of the Corn Exchange, where the paragraph now rendered unintelligible would read thus: "The order is an Italian Doric, the columns of which are so disposed as to form a parallelogram on the plan, having five intercolumns on each side, and three at each end, but in the upper part this shape is converted into an oblong octagon, the angles being cut off by the entablature being carried —— from the column next the extreme one to the corresponding column of the adjoining side. The attic and ceiling follow the plan of the entablature, and the second of them consists entirely of a very deep cove, through which the light is admitted by means of glazed compartments. The centre, however, or what would be the flat portion of the ceiling is neither glazed nor covered in at all, but forms an opening of thirty feet by ten (surmounted by a cornice and balustrade) consequently the shelter from rain is not altogether so complete as it might be."

Having quoted enough to correct the wholesale error on the part of the printer, by connecting the passages he had dissevered, we now proceed to make some remarks of our own, noting as a curious circumstance the alteration which has lately been made in the old or south area of the Corn Exchange, in order to shelter it from the weather, at the very time that a design has been adopted for the Royal Exchange, with an uncovered area or open cortile, surrounded as formerly by a covered ambulatory, which though protected from rain above, must be partially exposed to that, and to other inconveniences attending inclement weather—to damp, fog, and wind. We do not mean to say that Mr. Tite's design is at all more objectionable in that respect than were the others; on the contrary, it is far less so than the generality of them, on account of the very great depth, he has given to the colonnades. What strikes us as singular is that the Gresham Committee should have settled that very important point, for themselves beforehand, instead of allowing the competitors to have been guided as to it, by their own judgment. Had that been done the majority of them, we conceive, would have made their central area covered in,—unless deterred, perhaps, by the apprehension that it would be rejected as a new-fangled idea—an impertinent attempt to improve upon the former edifice.

The comments in the "Companion" on the Reform Club-house, will be best understood by referring to the ground-plan of that building, given in our last number; from which it will be apparent that by insulating the columns in the coffee-room, and placing them at some distance from the piers to which they are now attached, four colonnades or screens might have been formed with the same number of columns as at present. This would certainly have been attended with greater richness of effect, nor can we suppose that it escaped the architect himself; but it may possibly have been objected by the members themselves as tending to divide off the room too much, and to diminish its apparent spaciousness and extent. Yet—supposing this last notion to have been entertained, we consider it an erroneous one; for the appearance of extent would have been rather increased than at all diminished, by having a vista through a succession of spaces, one beyond the other—which would certainly have been more novel in character than the plan now adopted.

Of the new Church at Lee, Blackheath, which forms the subject of one of the cuts, a tolerably full account is here given, and it is spoken of as being greatly above the average quality of modern churches. Two circumstances are undoubtedly very much in its favour: one is that it has no side galleries; the other, that all the windows are filled with stained glass, "whereby a very unusual degree of richness and solemnity is imparted to the whole interior, so very different from that raw and garish, and we might almost say, 'worldly,' every-day light which prevails in the generality of our churches. These windows have been executed by Mr. Wailes of Newcastle, an artist who has here given proof of his study of ancient examples of the kind, particularly in the east window or windows, which have none of the gaudy, theatrical glare that is so offensive to good taste in many modern specimens of painted glass." Another specimen of superior design, here exhibited in an outline wood-cut, is the Catholic Chapel at Bury Lancashire, by Mr. J. Harper of York. The west front, which is the only part shown in the cut, displays exceedingly good taste, the design being composed of few features, but those well treated, and made the most of, so that there is, with much simplicity, a more than ordinary degree of richness, and boldness also. The octagon tower springing out above the gable, may be styled a novelty, although we believe that precedent may be found for it.

The Derby Arboretum, where Mr. E. B. Lamb was employed as the architect, and Mr. Loudon to lay out the grounds, is here noticed with deserved commendation, and as an instance of beneficially applied public spirit, on the part of its liberal founder Mr. Joseph Strutt, who seems to have very different notions of munificence from the late Sir John Soane. We hope that Mr. Strutt's noble example will not be lost upon others; for we are of opinion that public gardens and promenades of the kind are calculated to have a beneficial moral influence on the population of our towns. With this remark we take our leave of this new volume of the "Companion," which requires no farther recommendation from us than what we have already bestowed on its predecessors.

Schinkel: Werke der Hoheren Baukunst. Erste Lieferung. Potsdam, 1840.

It is somewhat premature to express any decided opinion as to this new and more costly series of designs by Schinkel, as this first Lieferung of the work contains only a portion of those for King Otho's Palace at Athens, nor does it comprise any letter-press. Still we are fain to make some remarks *ad interim*, both in respect to the general character of the publication, and the subject of the plates that have already appeared. It announces itself at first sight as an architectural *Prachtwerk*, and may therefore recommend itself all the more to some by its expansive size; but to many, we conceive, not only its size, but its shape will be objectionable, the form like that of the author's former series being an oblong folio, and this when opened extends to six feet! whereas had the upright form been adopted it would have opened only four feet. As regards the substance of the work, this is a matter of perfect indifference, yet it is a circumstance of considerable importance as regards its usefulness, because volumes of such ungainly dimensions and proportions are anything but convenient for reference, however well they may be adapted for occasional display; and at all events there was no occasion to enhance the inconvenience of size, by adopting the oblong shape, which last renders the work almost unfit for binding.

Whether many of the subjects are such as absolutely to demand plates of so large a size, we cannot at present tell. Probably there may be some interiors on a very large scale, but the subjects in the *Lieferung* before us, might have been just as well shown in plates of half the dimensions. For instance, the first plate exhibits a general elevation of the design for the palace on the Acropolis at Athens, and a section of the rock itself; but the buildings are on so small a scale that the whole of them do not occupy a space exceeding 20 inches in length by 4 in height, consequently a plate of half the size would have been ample enough. Besides, as the whole consists not of one uniform composition but of distinct ranges of building united together, the separate parts of the group might have been shown more advantageously on a much larger scale in one plate, by placing them one over the other, as is done in in the plate of the two sections. Unlike those in the '*Entwurfe*,' the elevation and the two sections are here shaded, and the former is coloured also; which we certainly do not think is any improvement upon the first work, for besides that the scale of the drawings is so small that shadowing renders their details indistinct: the elevation alluded to—which gives that of the remains of the Parthenon as seen before a part of the palace, consists of so many planes that pictorial effect is entirely out of the question, the whole having too much the appearance of a jumble. Neither is the colouring well executed in itself, being poor and washy, while the shadows are almost of a violet hue. Another circumstance which produces a more singular than agreeable effect, is that instead of being projected at an angle of 45 degrees, the horizontal shadows are so exceedingly broad that those of the cornices, notwithstanding that the latter have very little projection, extend to the lower facia of the architraves; which at first gives the idea of an unusually projecting roof. Colouring should, in our opinion, have been reserved for the perspective views and interiors. There is a larger outline elevation of one portion of the design, namely, of the façade of the Chapel at the south-west angle of the Palace, which enables us to judge of its style and details. It consists of a Corinthian monoprostyle, tetrastyle, projecting from the wider and loftier body of the Chapel, which like the portico itself is crowned by a pediment, and both pediments are enriched with sculpture. As there is only a lofty doorway within the prostyle, and the parts on either side of the latter are unbroken by windows, there is sufficient repose, and the advancing portico serves to give play to the composition. Yet if so far we are well satisfied with this elevation, there are other circumstances in it which are decidedly objectionable, the principal one of which is that though it is placed upon a lofty stylobate or platform, the ascent to the portico is by a narrow flight of steps in front, not exceeding the width of the centre intercolumn and the pillars forming it. Even in perspective the effect must be rather poor, and as shown in elevation it is quite disagreeable. Though their mouldings are sculptured, the cornices of the two entablatures are meagre in their profiles,—not at all distinguishable from Ionic; neither are the capitals marked by much of Corinthian luxuriance. We must confess that we are a good deal disappointed in the design generally, as here shown; for it does not realize the expectations we had formed of it, from what has been said on the subject of it by Quast, and the reviewer of his book, in the 35th Number of the Foreign Quarterly.

The combustion of Coals and the prevention of Smoke chemically and practically considered. By C. W. Williams. Part the First. Liverpool, Thos. Bean. London, J. Weale.

The object of this treatise is to show, on chemical principles, what errors are usually committed in the mode of burning coal in the furnaces of steam-boilers, and by what means the combustion of that fuel may be rendered the most perfect possible, and the formation of smoke effectually prevented. The style of the work is far from concise, yet, as the views therein set forth are based on sound principles, and their application (if found to be practicable, as asserted by the author) must be attended with great benefit, particularly to steam navigation, we confidently recommend it to the notice of steam engineers and others, to whom economy of fuel, and consequently the perfect combustion of coal, on the large scale of the furnace, is an object, being assured that the information gained will compensate for the *labour* of the perusal, although we think it might, with great advantage, have been condensed into one half of its present volume, if not less.

The author insists, with good reason, on the importance of attending to the chemical constitution of the fuel, and to the processes which go on, and the combinations which take place in the furnace during the progress of its combustion. He is, however, unreasonably fastidious with respect to certain received expressions, and frequently diverts the reader's attention from the immediate object of inquiry by ill-timed repetitions and observations, which render the perusal exceedingly tedious.

The 1st section treats of the constituents of coal, and the generation of coal-gas. In reading this, we were surprised to find that the author, who is so strenuous an advocate for accuracy of expression, even where it does not affect the facts considered, has himself, in one instance, made use of an inappropriate term, and that in a case where it has a tendency to mislead as to the main fact on which he is dilating. In the 22nd page he considers coal as consisting of two portions, viz., "the carbonaceous or solid, and the bituminous or volatile portions." Farther on he observes:

"The first leading distinction is, that the bituminous portion is convertible to the purposes of heat *in the gaseous state alone*; while the carbonaceous portion, on the contrary, is combustible *only in the solid state*;" and again,

"The bitumen of the coal, by reason of the great proportion of hydrogen which it contains, absorbs heat with great avidity, the first result of which is its change from the state of a *solid* to that of a *tarry, viscous, semifluid*; and, subsequently, by further increments of heat, to the state of gas, with its enormously expanded volume."

These quotations suffice to show that the gases which result from the application of heat to coal are considered by the author to be produced by a *simple distillation* of the bitumen contained in the coal, which suffers thereby no alteration in its chemical composition; whereas the truth is, that they result from the *chemical decomposition* of the bitumen, which, by the agency of heat, is resolved into a volatile portion, which is evolved in the gaseous form, and an excess of carbon, which remains behind in the solid state. Or rather, the coal should be considered as originally a homogeneous substance, which, by the action of heat, is first fused, and afterwards, when its temperature becomes sufficiently elevated, is decomposed as above. It will be evident, from these remarks, that the expressions "bitumen" and "bituminous portion" ought to be rejected, and "gases" and "gaseous or volatile portion" substituted in their place.

The 2nd section, which contains merely some general notions of gaseous combinations, is very tedious, and might, without detriment to the work, be omitted. We shall, however, just quote one specimen of the superfluous observations with which this work abounds. We read, page 36,

"Although, for the purposes of the *furnace*, so much value is set on the solid carbonaceous portion—the *coke*, we must not, on that account, undervalue the heat-giving properties of *the gas*. Indeed, the extent of those powers is strikingly brought before us by the fact that, for every ton of 20 cwt. of bituminous coal, no less than 10,000 cubic feet of gas are obtained, for which we pay at the rate of 10s. for every 1000 feet; the heating and lighting properties of the *gaseous portions alone* of one ton of coals thus costing five pounds sterling."

Is this fact a proof of the great value of coal gas as a heat-giving body? Certainly not; it is, on the contrary, rather an evidence of the great quantity of heat expended in evolving the gas, which is no advantage, but very much the reverse. This, however, is not the question; for, unless we are content to use coke from the gas-works, we must be at the expense of separating the gas from the carbonaceous portion of the coal, and all that remains to be considered is, what amount of heat is the gas, when separated, capable of evolving, how we can utilize the greatest possible proportion of that heat, and lastly, whether the amount gained is worth any additional expense which may be incurred in its attainment.

The 3rd section makes us acquainted with the proportions of carbon and hydrogen which constitute carburetted hydrogen gas, and with the quantity of oxygen necessary for the combustion of each of its constituents, as well as the quantity of atmospheric air which is requisite to furnish that quantity of oxygen. It should be here observed that the author has applied the term "atom" to atmospheric air, solely for the purpose of reducing the latter to an uniformity with the other gases concerned, being perfectly sensible that atmospheric air is not a chemical combination, but a simple mixture of oxygen and nitrogen gases, not exactly in the proportions required by the theory of chemical equivalents, the volume of the oxygen gas being 21 instead of 20 per cent. of the whole volume of air. This difference is neglected for the sake of simplicity. We have also to point out an error in page 51, lines 9, 10, 13 and 14, where "eight atoms of air" is put for "four atoms."

This section is followed by an explanation of two diagrams, representing the combustion of carburetted and bi-carburetted hydrogen, which present the volumes of gases used, and of the products of combustion, certainly in a very striking form, to the imagination of the reader, but we doubt whether a simple table of volumes would not have answered the purpose equally well.

In the 4th and 5th sections the author disposes of the questions of *the quantity of air required for the combustion of the carbon, after the gas has been generated*, and of *the quality of the air admitted to a furnace*. The 6th section treats of *the incorporation of air with coal gas, and the time required for effecting the same*, and the 7th of *the mode of effecting that incorporation in the furnace, preparatory to combustion*, which are very important points to be considered in the present investigation. In the latter the author explains the principle of his patent furnace, in which the air is introduced to the gases evolved from the coal by means of tubes pierced with numerous small orifices, the effect of which arrangement is compared to that of a blow-pipe.

The 8th and last section of this Part has reference to *the place or situation where the air may be admitted into the furnace*, so as to act its part with the greatest effect; and the conclusion arrived at is, for reasons therein developed, that the air for the carbonized fuel on the bars must come from the ash-pit, and that that for the gas must be introduced beyond the bridge.

Pambour on Locomotive Engines. London: John Weale, 1840.

(Second Notice.)

In our last number we were unable, for want of time, to give more than a very brief notice of this work, but we hope this month to make amends by analysing it throughout with that care which its importance deserves.

The mode of investigation adopted is briefly explained in the following paragraph, which we quote from the introduction of the first edition.

"The method constantly followed consists in taking, first, the primary elements of the question from direct experiment; then making use of those elements to establish a calculation in conformity with theoretical principles; and, lastly, submitting the results to fresh and special experiments, in order to obtain their verification. For the further elucidation of the formulæ, they are each time carefully submitted to particular applications; and, finally, to extend the use of the work to persons who may wish to find the results without calculations, the formulæ are followed by *practical* Tables, suitable to the cases which occur most frequently in practice."

The work is divided into 18 chapters, in which the various divisions of the subject are treated, followed by an Appendix, shewing the Expenses of Haulage by Locomotive Engines on Railways, from the Accounts of the Liverpool and Manchester, and the Stockton and Darlington Railways.

The first chapter is merely a description of a Locomotive Engine, and therefore needs no comment.

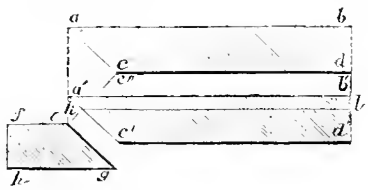
The second chapter, as we mentioned in our last number, is nearly a copy of the corresponding chapter of another work by the same author, entitled "*Theory of the Steam Engine*," a review of which will be found in the 2nd volume of this Journal, page 466. The present work contains, however, besides, in the 6th section of this chapter, a Table of 37 of the experiments made by the author with the view of ascertaining whether or not the steam left the Engine in the saturated state, that is, with the maximum pressure and density corresponding to its temperature, which experiments were merely alluded to in the above mentioned work. The results of these experiments are truly remarkable, since there is no exception to the perfect coincidence of the pressures, on the one hand, indicated immediately by the air-gauge, and on the other, calculated from the temperature marked by the thermometer. But, surprising as this coincidence is, we would by no means conclude therefrom, that such results were not actually obtained, being convinced of the fact which it tends to prove, viz. that the steam, after passing through the cylinder, leaves the engine in the saturated state; we would rather infer that the experiments were made with extraordinary care and with every precaution to avoid error.

The third chapter treats of the Pressure of the Steam, and Article 1. of the Safety-Valves in particular.

After explaining, in the 1st section, the mode of calculating the pressure according to the levers and the spring-balance, the author indicates, in the following section, the corrections to be made to the weight marked by that instrument. And here we cannot but express our dissent from the doctrine laid down with respect to the effect produced by the rising of the safety-valve on its surface exposed to the pressure of the steam. We read, page 90,

"......; but whenever the steam, being generated in greater quantity than it is expended by the cylinders, escapes with force through the valve, it raises considerably the disk of the valve: the consequence then is, that, instead of acting merely on the inferior surface of the valve, it evidently acts on a greater surface, and which is still greater the more the valve is raised."

It is to the latter part only of this proposition that we object. It is clear that the effective area of the valve must be augmented by its being lifted from its seat, and, if it is only raised a very minute quantity, merely sufficient to permit the escape of steam round the edge, the effective area of the valve will be increased from that of its lower to that of its upper surface; for in that case the steam, in passing through between the valve and its seat, presses against the whole conical surface of the former with sensibly the same pressure as exists in the boiler: but when the valve is raised considerably, as much for instance as twice its thickness, the steam, in escaping round the edge of the valve, will press on the conical surface of the latter with diminished force in consequence of the rapid enlargement of the space in which it is allowed to expand after having passed the lower surface of the valve. This will be evident on referring to the annexed dia-



gram, where $e\,f\,g\,h$ represents the valve-seat, and $a\,b\,c\,d$ one-half of the valve, in section, the rise $a\,e$ being equal to twice the thickness $b\,d$. Now it is clear that the steam will pass upon the lower surface $c\,d$ of the valve $a\,b$, and on the conical surface $e\,g$ of the seat with the whole pressure in the boiler, but that, after passing the contracted orifice $c\,e$ round the valve, it will immediately expand very considerably by reason of the rapid divergence of the surface $a\,c$ and $e\,f$, and will exert but a slight pressure on the conical surface $a\,c$ of the valve. But if the valve has only risen to the position $a'\,b'\,c'\,d'$, (supposing the rise $a'\,e$ to be very small,) the aperture for the escape of the steam becomes that represented by the line $e\,k$, at right angles to $e\,g$ and $a'\,c'$, so that the effluent steam will exert its full pressure, not only against the bottom surface of the valve, but also against all its conical surface from k ' downwards. On the upper part $a'\,k$ the pressure is but inconsiderable, as in the former case, so that the circle whose radius is $k\,l$ may be looked upon as a near approximation to the effective area of the valve; and it is obvious that this area is by so much the greater as the rise of the valve is less, which is in direct opposition to the law laid down by M. de Pambour. We should express the law in general terms thus:

When the valve rests upon its seat, its effective area is equal to that of its inferior surface, or rather of the orifice covered by the valve; when the valve first begins to rise, its effective area is equal to that of its upper surface; and, as it rises more and more, the effective surface goes on diminishing, but according to a law which remains to be determined.

We therefore consider the calculation in pages 90 and 91 as fallacious.

Before quitting the subject we shall just offer a remark on the paragraph which closes this article, which is the following:

"The above established calculation, then, is to be depended on only when the balance-screw can be lowered so as precisely to equilibrate the interior pressure, as has been said above, without, however, allowing the valve to rise. But the thing is not possible when the engine produces a surplus of steam beyond what its cylinders can expand, because this steam must necessarily have an issue. In this case, then, the pressure is to be found only by recurring afterwards to the barometer-gauge, as we shall presently indicate."

It seems the most natural hypothesis, that, the blowing of the valve is a sign that more steam is generated in the boiler than can be expended in the cylinder *without raising the pressure in the boiler*, and that the blowing may *always* be prevented by a suitable augmentation of the weight on the valve.

The second article, which completes this chapter, contains a full description of the four instruments employed by the author to determine the pressure of the steam, with an explanation of the mode of using them, namely, the *barometer-gauge*, the *air-gauge*, the *thermometer-gauge*, and the *spring-gauge* or *indicator*.

The fourth chapter treats of the Resistance of the Air, and we are sorry to find this subject not so fully elucidated as we had hoped.

The apparently anomalous result observed by Borda, and confirmed by M. Thibault, namely, that large surfaces experience a greater resistance from the air in proportion to their area than smaller ones, when submitted to a circular motion round an axis situated in the same plane as the given surface, was easy to foresee. But, as M. de Pambour has neglected to give the explanation of it, we shall do so, in order that those, to whom the true reason may not occur, may not reject the proposition as absurd. The explanation will be found in the following calculation.

Let a square surface whose side $= a$ revolve round an axis, situated in the same plane as the given surface and at a distance r from its centre. Let the velocity of the centre $= v$, and let $\rho =$ the resistance of the air against an unit of surface moving at the unit of velocity, and R the resistance on the whole given surface. The resistance on an element of the surface extending across its whole width, and at a distance x from the axis of rotation will be

$$d.R = \frac{a\,\rho\,v^2}{r^2}\,x^2\,d.x;$$

whence we obtain by integration

$$R = \frac{a\,\rho\,v^2}{3\,r^2}\,x^3,$$

and, putting for x its maximum and minimum values, namely, $r + \frac{a}{2}$ and $r - \frac{a}{2}$, we have, for the resistance on the whole given surface,

$$R = \frac{a\,\rho\,v^2}{3\,r^2}\left[\left(r+\frac{a}{2}\right)^3 - \left(r-\frac{a}{2}\right)^3\right]$$

$$\text{or} \qquad R = \frac{a^2\,\rho\,v^2}{3\,r^2}\left(3\,r^2+\frac{a^2}{4}\right).$$

The resistance on an unit of area will be found by dividing the total resistance R by the area of the surface, which is a^2. We have therefore, calling π the mean resistance per unit of area under the above circumstances,

$$\pi = \frac{\rho\,v^2}{3\,r^2}\left(3\,r^2+\frac{a^2}{4}\right) = \rho\,v^2\left(1+\frac{a^2}{12\,r^2}\right).$$

The term $\frac{a^2}{12\,r^2}$ shews that the above quantity increases with the ratio of the area of the surface to the square of the distance of the centre of the surface from the axis of rotation, so that, if this distance is constant the resistance per unit of area is greater for a large surface than for a smaller one, and that the same effect is produced by lessening the distance from the axis of rotation to the centre of the surface.

It is essential, therefore, as the author observes, that, when the circular motion is used to determine the resistance of the air, that the surfaces employed should be of very small extent compared to the length of the radius of rotation.

The following formula, to determine the resistance experienced by a body moving in the air at rest, is deduced from the experiments of Borda, Dubuat and M. Thibault.

$$Q = \cdot0011896\,\epsilon\,\Sigma\,V^2,$$

in which Q is the total resistance in lbs., V the velocity of feet per second, Σ the front surface of the body, traversing the air in a direction normal to that surface, and ϵ a coefficient which varies with the length of the body.

In applying this formula we must make

for a thin surface - - - - - - -	$\epsilon = 1{\cdot}43$
for a cube - - - - - - - -	$\epsilon = 1{\cdot}17$
for a prism of a length equal to 3 times the side of its front surface - - - - - -	$\epsilon = 1{\cdot}10$.

In the 2nd section the author has given a table of 6 experiments on the resistance of the air against trains. Five wagons of different heights, loaded with goods, were drawn to the top of the Whiston inclined plane on the Liverpool and Manchester Railway, and were allowed to descend by their own weight, first separately, and afterwards all united in one train.

The comprehension of this table would have been greatly facilitated if the author had given some fuller explanations of the manner in which he determined the last number in the 8th column, expressing the effective surface exposed to the shock of the air, which gives, for the five wagons together, a friction equal to the sum of the frictions of the five wagons separate. We have worked out the formula given in page 152 with different areas of effective surface, and find the friction amount to 5·92 lb. per ton with 144 square feet, and not 130, as given by M. de Pambour. The surface of the highest wagon, augmented by that representing the resistance of the wheels and screened parts of all the five wagons, is equal to 127 square feet, and as we have found the effective surface of the train to be 144 square feet, we must add $4\frac{1}{4}$ square feet per wagon, with the exception of the first, so that the effective surface will be found by adding to the area of the wagon of greatest section six square feet for the first, and $13\frac{1}{4}$ for each of the following wagons.

Assuming the value of V, or the velocity at the foot of the first plane to be correctly given by the question in page 148, we found that the hypothesis of any thing approaching to uniformity of motion could not by any means be reconciled with facts, but that by taking $\frac{4}{5}V^2$ as the mean for the first plane, and $\frac{9}{10}V^2$ for the second, the resistance of the air was correctly given by the equation we have quoted above. The square of the velocity at $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ of the length of the first plane are found by the above mentioned formula to be respectively equal to $\cdot 326\ V^2$, $\cdot 623\ V^2$ and $\cdot 864\ V^2$.

To simplify the calculation for general purposes a mean value of ϵ, namely 1·05, which is suitable to a train of 15 wagons, is substituted in the above formula, which thus becomes, when the the velocity is expressed in miles per hour,

$$Q = \cdot 002687\ \Sigma\ v^2.$$

This chapter concludes with a practical table of the resistance of the air against trains at velocities commencing at 5 miles an hour, and increasing by 1 mile at a time up to 50, the effective surface of the train increasing by 10 square feet at a time from 20 to 100. The resistance is expressed in lbs. on the whole train and on the square foot of effective surface.

Chap. V. On the friction of the wagons on Railways.

The only means of ascertaining the friction of wagons with any degree of certainty is by the circumstances of their spontaneous descent and stop upon two consecutive inclined planes. We therefore pass to the 3rd section of this chapter, which is an analytical investigation of these circumstances, as referring to a system of two wheels joined together by an axle-tree fixed invariably to each, and loaded with a given weight resting on a chair on which the axle-tree may turn freely.

"The inquiry comprises three successive questions: 1st. To determine the effective accelerating force to which the centre of gravity of the system will be subject in its motion; 2nd. To deduce from this the velocity acquired by the moving body at the foot of the first plane; and 3rd. To conclude finally the distance it will have traversed on the second plane at the moment when the friction shall have reduced its velocity to nothing,"

The motive forces applied to the system are first enumerated, in which the author includes, besides the motive forces properly so called, the passive resistances which oppose the motion, and which are generated by the motion itself. Among these there is one regarding which we think the author is in error, namely, the adhesion of the wheel on the rail. "It is this force," he says, "which produces the rotation of the wheel, by preventing its circumference from sliding without turning during the motion along the plane." This force is expressed by the weight T.

If this ought to be looked upon as a force, there must also unquestionably be an expenditure of power without any resulting effect at the fulcrum of every lever, for, as the above quotation proves, it is only in its capacity of fulcrum that the point of contact of the circumference of the wheel with the rail is here considered; what is called the rolling friction occupies the 6th and last place in the list.

It is a curious fact that this introduction of a false idea does not in any way influence the final result of the calculation: it serves merely to form an unnecessary intermediate equation, between which, and the principal equation when the quantity T has been eliminated, the resulting equation is the same as if that quantity had never entered into the calculation.

The two equations in question are

$$P \sin\theta' + p \sin\theta' - T - Q\ v^2 = \frac{P+p}{g}\ \phi,$$

$$\text{and}\quad T\ R - f'\ P r \cos\theta' - f''\ (P+p) \cos\theta' = \frac{p}{g}\ k^2\ \psi,$$

in which P is the weight of the chair with its load, resting on the axle-tree, p that of the wheels and axle-tree, θ' the inclination of the plane to the horizon, v the velocity of motion at any moment, $Q\ v^2$ the resistance of the air at that velocity, g the force of gravity, ϕ the effective accelerating force which produces the motion of translation of the system, ψ the effective accelerating force which produces the rotation of a point of the wheel situated at the distance 1 from the axle, $\frac{p}{g}\ k^2$ the momentum inertiæ of the wheel, R the radius of the wheel, r that of the axle, f' the coefficient of sliding friction, and f'' that of rolling friction.

Now the former, or princippal of the above equations ought evidently to have been

$$P \sin\theta' + p \sin\theta' - f'\ P\ \frac{r}{R} \cos\theta' - f''\ (P+p)\ \frac{1}{R} \cos\theta' - \frac{p}{g}\ \frac{k^2}{R}\ \psi - Q v^2 = \frac{P+p}{g}\ \phi.$$

Substituting $\frac{\phi}{R}$ for ψ, and 1 for $\cos\theta'$ as a sufficiently near approximation when the plane is but little inclined, and making

$$f'\ P\ \frac{r}{R} + f''\ (P+p)\ \frac{1}{R} = f\ (P+p),$$

we obtain

$$(P+p) \sin\theta' - f\ (P+p) - \frac{P}{g}\ \frac{k^2}{R^2}\ \phi - Q\ v^2 = \frac{P+p}{g}\ \phi.$$

Whence

$$\phi = \frac{g}{1 + \frac{p}{P+p} \cdot \frac{k^2}{R^2}}\ (\sin\theta' - f - \frac{Q}{P+p}\ v^2).$$

This is precisely the equation arrived at by M. de Pambour, page 145, which is transformed, for the sake of simplicity, into the following,

$$\phi = g'\ (\sin\theta' - f - q\ v^2),$$

the frictions represented by g' and q containing none but known quantities.

The accelerating force being equally represented by $\frac{v\ d\ v}{d\ x}$ (x being the distance traversed on the plane when the body has acquired the velocity v), this expression is substituted for ϕ, as well as b' for $\sin\theta' - f$, in the last equation, which thus becomes

$$\frac{v\ d\ v}{b' - q\ v^2} = g'\ d\ x,$$

which is the equation of the motion, and gives by integration between the limits $x = o$ and $x = l' =$ the length of the plane, calling V the velocity acquired at the end,

$$2\ q\ g'\ l' = \log.\ \frac{b'}{b' - q\ V^2},$$

whence

$$q\ V^2 = b'\ \left(1 - \frac{1}{e^{2 q g' l'}}\right).$$

This gives the velocity at the end of the first plane, and consequently at the beginning of the second. The question now is to determine at what point of the second plane the body will stop, to solve which we have, calling θ'' the inclination of this plane, all the other circumstances of the motion being the same as before, except that, the inclination of the plane being so much less, that the body is brought to rest, the accelerating force $\frac{v\ d\ v}{d\ x}$ is negative,

$$\frac{v\ d\ v}{d\ x} = -g'\ (b'' + q\ v^2),$$

— b'' being substituted for $\sin\theta'' - f$.

Making, after integration, $x = l''$ for the distance traversed on the second plane, and $v = o$, since the body is brought to a state of rest, putting also for $q\ V^2$ its value found above, we have

$$\frac{b'}{b''} = \frac{e^{2 q g' l''} - 1}{e^{2 q g' l'} - 1}\ e^{2 q g' l'}.$$

Finally, restoring the values of g', b' and b''; and calling h' and h'' the vertical heights descended on the first and second planes respectively, and making

$$Y = \frac{l'}{l''} \frac{e^{\frac{2qgl''}{n+1}} - 1}{e^{\frac{2qgl'}{n+1}} - 1} e^{\frac{2qgl'}{n+1}}$$

we obtain definitively for the value of the friction f,

$$f = \frac{h' + h'' Y}{l' + l'' Y}.$$

We have been involuntarily led, by the ingenuity of this method of eliminating the resistance of the air, into giving a complete sketch of the calculation, but we do not think it more than sufficient to give an adequate notion of its nature and perfection.

The fourth section contains an account of 12 experiments made on the above principle on the Whiston inclined plane on the Liverpool and Manchester Railway, with trains consisting of different numbers of wagons and variously loaded, the results of which are collected in a table at page 161.

From these experiments, the mean friction of the wagons, taken independently of the resistance of the air, amounts to $\frac{1}{389}$ of their gross weight, or to 5·76 lb. per ton: but to simplify the calculations, M. de Pambour takes it at 6 lb. per ton, which makes $\frac{1}{373}$ of the weight of the wagons. He remarks, however, that, except in cases of extreme velocity, the resistance of the air may be computed with regard to the wagon of greatest section alone, according to Borda, taking the friction then at 7 lb. per ton.

Chap. VI. treats of the Gravity on Inclined Planes, and Chap. VII. of the Pressure produced on the Piston by the action of the Blast-pipe. This is a very important point, and requires much more experience and careful investigation, in which the results of experiment are compared with the laws of Natural Philosophy, before it can be considered as satisfactorily settled. In comparing the last column of the Table of Experiments, page 193, with the last but one, we find some great discrepancies, although the coincidence is in some cases perfect or nearly so. For example, we find the pressure on the piston due to the action of the blast-pipe,

		Observed. lbs.	Calculated. lbs.	Difference. lbs.
in one experiment	....	5·0	3·6	1·4
in another	....	5·6	4·2	1·4
"	....	5·8	4·1	1·7
"	....	5·3	4·1	1·2
"	....	6·2	4·4	1·8
"	....	2·4	3·4	1·0
"	....	5·6	4·5	1·1
"	....	1·8	4·2	2·4
"	....	1·0	2·7	1·7
"	....	1·2	2·5	1·3
"	....	5·0	6·7	1·7
"	....	3·4	5·5	2·1
"	....	4·3	4·1	0·2
"	....	1·8	1·8	0·0
"	....	2·4	2·1	0·3
"	....	2·3	3·1	0·2
"	....	2·3	1·9	0·4
"	....	2·0	2·1	0·1
"	....	2·4	2·6	0·2
"	....	3·8	3·4	0·4
"	....	2·1	2·0	0·1
"	....	6·0	5·7	0·3

Out of 38 observations given in the table, the last ten of the above selection present the nearest accordance with the numbers calculated by M. de Pambour's formula, while the first 12 exhibit discordances too great to permit us to consider that formula as confirmed by the experiments alluded to. We must, however, content ourselves with these determinations for the present, for want of more accurate data, but we hope the invesgation will not be allowed to rest here, since the theory of the Steam Engine is not complete without it.

This chapter concludes with a *practical table of the pressures against the piston, due to the action of the blast-pipe*, which furnishes the means of taking this effect into account in some degree, which is better than neglecting it altogether.

In chapter VIII. the friction of the engines, both unloaded and loaded, is very ably investigated, and illustrated by experiments, and in chapter IX. is ascertained the definitive resistance per unit of surface of the area of the piston resulting from the various resistances estimated in the preceding chapters.

In chapter X. are presented the details of 22 experiments on the vaporization of locomotive engines, together with an inquiry into the circumstances which influence the rate of vaporization, which tends to prove, 1stly, that this is not affected by (the load on the safety-valve) or pressure of the steam formed, 2ndly, that it increases with the velocity of the engine, all other circumstances being the same. The author even goes so far as to conclude from those experiments which bear on this point that the vaporization of locomotive engines varies very nearly as the fourth root of the velocity. We do not feel justified in adopting such a law on the strength of so few experiments, which do not *all* concur even in establishing the general truth. That the velocity of the motion does influence the vaporization we are not, however, disposed to doubt; we only wish to intimate that more numerous experiments must be made on the subject before the law of that influence can be deduced. 3rdly, it is shewn from the experiments, three of which were made without the blast-pipe, that this appendage to a locomotive engine increased its vaporization more than five-fold, but that the narrowing more or less of the orifice of the blast-pipe produced no very remarkable result. It appears, however, that a certain area or orifice produces a maximum effect for each engine, that area being for the STAR engine, according to the experiments here reported, about 3·13 square inches.

In the 5th section of this chapter, which treats *of the comparative vaporization of the fire-box and the tubes, and of the definite vaporization of the engines per unit of heating surface of their boilers*, the author asserts, page 270, that, "during the active working of engines of a construction similar to that of the experiments, the two portions of the boiler vaporize, per unit of surface, the same quantity of water." This equality is ascribed to the fact of the flame being drawn, by the force of the blast, through the whole length of the tubes, by which means the whole of their surface is exposed to radiating caloric, but there are probably other circumstances which tend to equalize the two portions of the boiler as to their evaporating power, as for example, the superior conducting power of the thin brass of the tubes over that of the iron plate of which the fire-box is made.

In the 6th section an estimate is made of *the loss of steam which takes place by the safety-valves, during the work of locomotive engines;* but it does not appear that there are any positive data on which to found the assumption of the losses here assigned. The calculation is based on the rising of the valve observed during the experiment compared with the rise which is sufficient to give issue to all the steam generated during the complete close of the regulator, without regard to the pressure in the boiler, which must doubtless influence the loss through the valve considerably.

In the 7th section the quantity of water drawn into the cylinders in the liquid state is shewn to amount to a considerable proportion of the water appended: the average of the severe experiments in the table at page 289 is 24 per cent., and in one case it appears to have risen to 36 per cent. But as the determination of this quantity necessarily depends upon that of the loss of steam through the safety-valves, it must be affected by whatever errors there may be in the latter. We think it probable that the escape of steam through the valve is more copious than M. de Pambour calculates it to be; in which case the loss by *priming* would be found to be less considerable. We are, however, compelled, in this instance also, to content ourselves for the present with the data here furnished us. Besides, as we are possessed of the facts ascertained by experiments, we must take it for granted, that there is no great error in the total loss both by the safety-valve and by *priming*, as the only difficulty consisted in distributing it between these two causes.

The explanation of the manner in which a deficiency of steam-room in a boiler causes it to prime is not applicable to a locomotive engine for it does not follow, because that space is but 10 times the capacity of the cylinder, that "at every stroke of the piston, a tenth of the steam generated will pass into the cylinder," and that "the remaining steam will be all at once reduced to 9-10ths of what it was before." The truth is that there is no cessation either of the generation or supply of steam to the cylinders: the latter is at no instant more than once and 4-10ths as rapid as at another, and is at the least nearly 8-10ths of the average supply.

In chapter XI. the subject of Fuel is treated in a very scientific and practical manner, both with reference to the absolute quantity which locomotives of different constructions are capable of consuming, and also with reference to the consumption required to effect a given vaporization.

From the experiments on this subject, of which the particulars are given in the 1st section of this chapter, and which are grouped in a table, page 298, according to the proportion between the heating surface of the fire-box and of the tubes, the author concludes in the following section that the most advantageous proportion is as 1 to 9, or the total heating surface equal to ten times that of the fire-box; "since for a less proportion there would be increase in the expenditure of fuel, without increase of vaporization: and for a greater proportion, on the contrary, there would be reduction in the vaporization of the engine per unit of surface, which would incur the necessity of a larger boiler, and consequently of a greater weight, which it is important to avoid."

It also results from these experiments that, "according to the proportion of the fire-box to the total heating surface, the consumption of fuel in locomotive engines varies from 9·2 to 11·7 lbs. per cubic foot of *total* water vaporized; so that it may, on an average, be valued at 10·7 lbs. of coke per cubic foot of total vaporization."

It is to be observed that this *total* vaporization includes the loss by priming, so that the quantity of coke per cubic foot of water really converted into steam would be, according to M. de Pambour's calculation, about 14 lbs.

Of the 12th chapter, which treats of the Theory of locomotive engines, we shall merely observe that it is in substance the same as in "The Theory of the Steam Engine," to which work we have already alluded, but much more instructive with regard to locomotive engines, the peculiar circumstances of which are here discussed at much greater length. The application of the the theory is rendered easy by practical formulæ and examples, and its correctness corroborated by applying it to the results of a considerable number of experiments, collected in a table at the end of the chapter.

The theory is continued in chapter XIII., in the first 9 sections of which are solved the various problems which occur in the construction of locomotive engines, viz., to determine the vaporization or heating surface, the dimensions of the cylinders, and the diameter of the wheel, necessary for the engine to draw a given load at a given velocity; to determine the vaporization or heating surface, the pressure in the boiler and the dimensions of the cylinders, necessary for an engine to assume a given velocity or draw a given load, producing at the same time its maximum of useful effect; and lastly, to determine the combined proportions to be given to the parts of an engine, to enable it to fulfil divers simultaneous conditions. The utility of all these problems is too evident to require pointing out.

In the 10th section, which is an examination of the special influence of each of the dimensions of the engine on the effects produced, we have to direct attention to a slight contradiction. We read, page 417,

"Moreover, it will also be recognised that, for a given vaporization, the velocity will be by so much the greater as the factor $\frac{d^2l}{D}$ has less value. It is in consequence to be concluded that, in order to augment to the utmost the velocity of an engine with a given load, we must either employ a cylinder of the smallest possible diameter, or make the wheel the largest possible with reference to the stroke of the piston."

It is a more direct inference that we must employ a cylinder of the smallest possible capacity in proportion to the diameter of the wheel. We read further:

"These consequences might however have been seen *à priori;* for if we suppose a given vaporization in the boiler, it is clear that the quantity of steam which will result from it per minute cannot issue forth in the same time by a cylinder of less diameter, except on the condition of increasing its velocity during its efflux, that is, of increasing the velocity of the piston. As to the ratio between the length of the stroke of the piston and the diameter of the wheel of the engine, as it is known that at every double stroke of the piston the engine advances one turn of the wheel, it is readily perceived that the larger the wheel relatively to the stroke of the piston, the greater must be the velocity of the engine with a given load."

In all this reasoning the author has lost sight of the circumstance that a diminution of the capacity of the cylinders, *with a given load,* will necessarily demand steam of a greater pressure, and consequently of greater density, in the cylinders: but, as the density of steam does not increase in proportion to its elastic force, there will be a slight increase of velocity with the smaller cylinders.

A little farther on, page 419, we are told that the load which an engine is capable of drawing at a given velocity "is diminished by the values of d, l and D, that is, by the dimensions of the cylinder, the stroke of the piston, and the wheel, which are proper to augment the velocity of the engine."

We were at first puzzled for an explanation of this contradiction, but, on examining the two equations from which the above deductions were drawn, we perceived that the latter were not justified by them, but that the same values of d, l and D which would increase the velocity with a given load would also increase the load with a given velocity, the fraction $\frac{d^2l}{D}$ being *positive* in the *denominator* of one of the fractions, and *negative* in the numerator of the other. The error we have pointed out runs through the rest of the section.

(To be continued.)

Specifications for Practical Architecture, preceded by an Essay on the Decline of Excellence in the Structure, and in the Science of Modern English Buildings. By Alfred Bartholomew, Architect. London: John Williams, 1840.

We have so often made an attempt to examine this important work with the attention it deserves, that we fear we may be considered remiss by our readers in not attending to it before—the fact is that it contains so much matter intimately connected with the profession, that it is with difficulty we can select any one part in preference to another, a difficulty increased by the arrangement of the work. We have already, by permission of the author, given large extracts, which will be a sufficient testimony to our readers, that it is a work well deserving of the attention of every one connected with building, we will not say the profession alone, for it is equally as well deserving the notice of the public generally. Having said thus much, we must not be considered as agreeing with all the sentiments and opinions of Mr. Bartholomew, although we believe that what he has written, has been done in sincerity: we think that he has been too much imbued with the Wren-mania, and considers that nothing is now done equal to the buildings and architecture of the period previous to the eighteenth century—no doubt, many of our public edifices built during that period were executed with great judgment, but we know that many of them possess faults, nay very great ones; for how many of them do we find that have lossed their spire or steeple, and in others the piers of the main tower have given way, under the great pressure which they are made to carry. Nor do we find that all the buildings of that period were erected *fire proof*—we believe that very few of them have their vaulting of stone, some we have seen which so closely resemble stone, that they have been taken for that material until the visitor is told to the contrary. Although, during this period there were erected numerous ecclesiastical buildings, possessing architectural merit of the highest class, we should like to know how many buildings of a domestic character were erected, possessing any claim to architectural pretensions, in comparison with those which have been erected within the last century—now, the whole of a man's fortune is not placed at the mercy of the priest, for external pomp to support an intolerant church or to prevent the soul from going to purgatory: no, part of that fortune is now devoted to the erection of edifices, which form an ornament to many parts of the united kingdom, and we hope to see them still farther increase.

Another part of Mr. Bartholomew's bewailing is on account of the use of Bath stone and cement; no one will dispute that if you can obtain funds sufficient, that it is far better to use Portland stone, but the immense cost of labour on that material is a bar to its general introduction, and it is on account of the cheapness and facility in the use of cement for giving architectural character to our buildings, that it is so largely introduced. We believe that the fault in the use of it is by allowing the workman to have cement of an inferior quality, or in permitting it to be employed by men that do not know how to mix or apply it.

That part of the volume which treats upon Specifications, possesses some very useful hints for those who are not well conversant with that branch. We feel ourselves very strongly inclined to recommend that specifications should at all times be drawn up by parties who will make it their peculiar study; such a person would be of as much service to the architect, as the special pleader or equity draughtsman is to a lawyer.

The information on construction will be found valuable to the student, who will do well to peruse attentively the general contents of the volume.

We think the work would have been clearer had it not been split up so much into chapters and sections, which however convenient for reference, are embarrassing to the reader. This is even carried out in the specifications, so that a specification is interrupted by chapters and sections. We must not, however quarrel with Mr. Bartholomew, for he is too steady a reader of the Journal not to enlist our sympathies: some of our correspondents however seem, by the remarks in his work, to give him a good deal of trouble. He devotes especial mention to Candidus. We must now leave Mr. Bartholomew, and his work with a hearty commendation to our readers for its usefulness.

THE ARCHITECTURE OF LIVERPOOL.

By a Stranger.

Not deeming myself bound to continue these remarks according to any fixed rule, I shall merely note each of the "Architecture of Liverpool" as comes first in my way, during my peregrinations through the town, without regard to their proximity to each other or even their relative importance. I shall, therefore, now turn my face towards the place where the wise men of old came from, namely, the east, and make a few remarks on the Railway Station. This is a mere screen, little better than a blank wall, hiding, instead of setting off, the great works that are going on behind it. It is a long, low, flat facade, broken into many unmeaning parts, without end or aim, having six and thirty engaged columns very nearly in a line, like a regiment of soldiers leaning against a wall, set upon pedestals, and supporting an entablature, and over the centre and side entrances having heavy masses of stone-work. This station is a great failure. Instead of being a grand substantial gateway, suitable to the commercial dignity of this great town, and the incalculable importance to mercantile men of railway transit,—instead of an entrance suitable in height and dignity to so important an object, which, by its outward appearance, should tell of the great things going on behind it, and thus serve as a title page to its contents, here is a long, low wall, ornamented, it is true, with columns, &c., but still giving no one any idea, by its outward expression, of its nature or intents. Every edifice should express its object. A church should display gravity and dignity, a theatre lightness and gaiety, a prison rude majesty and sturdy strength: in short, every edifice should, like the countenance, express the spirit. But, in this erection, besides this want of expression for the intended object, the thing is not good in itself. The expression of a column is that of support to something superincumbent. But what do these support? Why, they are themselves stuck against a wall where they are not required, for, we naturally suppose, a wall can support itself; and over them is an entablature, which might, also, have been supported by the said wall. Moreover, this entablature is in itself but indifferent, and it is broken into petty parts, wanting that continuity of outline so necessary in large edifices for effect and dignity; and all this is to no useful purpose, but merely to hide the railway. How much better would it have been to have made these now useless columns available, and placed them at the outside of the pathway, thus forming a colonnade, for shelter from sun and rain, with bold but unbroken entablatures; and, in the centre, made a very large and handsome gateway, worthy of the town, somewhat similar in style to those of Birmingham and London, albeit they are not quite faultless. But I must, in justice, add, that the columns are well wrought and proportionate, the mouldings good, and the basement and pedestals bold, substantial, and somewhat original.

One of the most important architectural edifices in the town, as well from its size and prominent position as from its cost, is Saint Luke's Church, which crowns the summit of a gentle ascent, and forms a beautiful termination to the view at the south-east end of Bold-street. It is one of the finest and most picturesque buildings of its kind in the county. This has been a most successful attempt at the opprobriously termed Gothic, a name sarcastically applied to the sublime architecture of the middle ages, by Sir Christopher Wren, whose own tasteless attempts in that style show how little he understood the artist-like feelings or the grand conceptions that enabled the monastic architects to raise edifices remarkable for boldness, scientific construction, and that fascinating and almost magical effect of chequered light and shade, which, combining, at times, the most playful effects, as in their small oratories and chapels, and, at others, the most sublime and elevating, raising the feelings of the devout, and appalling even the infidel, produced architectural effects that have not been equalled even in the present day of knowledge and enlightenment. St. Luke's Church consists of a nave, chancel, and tower. The details of the exterior of this church are exceedingly good, and show that the architect had a chaste appreciation of that style. The windows, battlements, buttresses, pinnacles, &c. are almost all unexceptionable, which, with the admirable tone of colour in the stone, produce a very fine effect. The chancel is a copy of the Beauchamp Chapel, at Warwick. This chancel, though beautiful enough in itself, looks sadly likely an excrescence or after-thought, tacked on to the main building, which idea is still further kept up by the difference of style, which is of later date than that of the nave. Why should this have been done in a modern edifice? Why, in an edifice built at the same period, combine the incongruous styles of several periods? for, in the Gothic style, there are many eras, each characterized by certain distinct features essentially different from all the rest: and thus the antiquary may trace the date of erection of almost any ancient building to within a very few years. It may be replied, that there are remains of many buildings of different styles. True. But the reason is, that they were built at different periods, each in accordance with the style of its own date, thus creating a great jumble of styles, often picturesque, but rarely chaste or correct, or forming one homogenous mass. Nor can any one produce a single ancient edifice built at the same period but in different styles. Thus we plainly see, that this mixing of styles is neither in accordance with reason nor the beautiful examples of antiquity now remaining unto us. The tower of this church is square, with turrets at each angle running up, and finishing with small battlements. The lower part contains a deeply-recessed doorway, with bold shafts and mouldings. Above is a "*perpendicular*" window, which is somewhat disproportionately short. The clock, in the centre of a row of panelling, comes next, and then the belfry-window, of *decorated* character, being filled with flowing tracery. The upper part of the tower is finished with a profusion of graceful panelling, and terminated with perforated battlements of chaste design. The whole is exquisitely beautiful and picturesque: nor do I know any *modern* tower which has so fine an effect as this. Whether the sun shines broadly over its top, as it stands boldly out against the clear distant blue of the sky, or clouds chequer the face, the effect is equally beautiful, combining fair proportions with the chastest details. But there is, I think, one anachronism that, to an antiquarian eye, mars the whole: it is like the mole upon the fair face of some otherwise exquisitely beautiful girl. The lower window is of about the date of 1450, that of the upper one about 1370, and is copied, I suspect, from one in Worstead Church, Norfolk. Therefore, even if the tower were built to imitate different periods, which I can hardly imagine, they have placed the oldest style upon the top of the more modern one; so that an Irishman might blunder upon the idea, that they had commenced building at the top, and gradually travelled down to modern times. One has heard of "building castles in the air:" surely the architect of this edifice intended to illustrate the saying. The ground on which this edifice is built being much higher at one end than the other, the architect, by way of obtaining a level, has constructed a large and handsome flight of steps, though somewhat too high, at one end, occupying the whole width of the edifice. This gets over the difficulty: but, although this may be a beauty to a Grecian temple, which was always placed upon the uppermost of a flight of steps surrounding the building, it is inconsistent with this style of architecture, and but few examples remain of such, except here and there upon the continent. Of the interior, with much that is good, there is much that is indifferent: the details are often excellent in design, but poor in execution, not having sufficient boldness or projection. The cornice from which the roof springs, especially, is much too small, the bases of the piers are miserable, the shafts against the outer wall, supporting the aisle roof, are poor and thin: but yet, with all these defects, in consequence of the excellence of other parts, the absence of that great defect in Gothic architecture, side galleries, and the expense lavished upon the whole, there is an effect produced that is highly pleasing, and renders the *tout ensemble* of this edifice one of the finest of its kind in this county, if not in the country. The entrance gates are much too small and unimportant, and resemble the upper portions of pinnacles cut off and placed there, and are, besides, much too numerous. How much better would have been large, bold, and handsome piers, or arched gateways, than these expensive frittered pieces of gingerbread, which must, altogether, have cost many, many hundred pounds.

Few things more strike a stranger's notice, or give him a better idea of the wealth of this most wealthy town, than the number and excellence of the banking-houses. To offer remarks upon a very small number would extend these papers too far, but there are two just completed that may be worthy of notice, viz., the North and South Wales Bank and the Union Bank. The former is one of the handsomest in the town; but, in criticizing any architectural work, the critic should make himself acquainted with the peculiar circumstances under which the architect was placed, and endeavour to discover what control they exercised over his design. Upon a cursory examination of this bank, it is evident the architect had to contend with difficulties of no mean order, such as his ground being irregular in shape, and, also, the necessity of getting sufficient accommodation within a very confined space, thus compelling him to obtain in height what he wanted in superficies; and, yet, here are enormous difficulties overcome, and a handsome edifice, in conclusion, remains. The entrance front consists of a Corinthian portico, *in antis*; the columns, which are very rich and handsome, being just disengaged from the wall and set upon pedestals, the whole being surmounted by a pediment, with rich cornice, &c. There are, in the centre, a doorway and two windows, one above the other, but the ornaments of all these are inferior to the rest of the work. The side consists of a row of six pilasters and three tiers of windows, the lowest range having three, circular-headed, with keystones, the place of the other two being occupied by narrow doorways. This building is too high, the entrance too narrow, the doorways, columns, and pediment cramped: but, it is also evident, the architect had no control over these: it was the stern necessity, arising from want of space. This must also excuse the narrow doorways of the side, although it will not do so the swelled frieze over it, a licentious practice, made use of in few buildings of importance, except the Temple of Bacchus, near Rome, the Basilica of Antoninus, and afterwards by Palladio, in the Rotunda of Capra, and a very few others. The cornice of this building is remarkably fine, and, in the order of its mouldings, resembles those of the Temple of Jupiter Stator, in the Campo Vaccino, the whole of which is considered to be the finest specimen of the Corinthian order in the world. One regrets, that want of means, or some other cause, prevents the least exposed sides of this edifice being finished in the same style as the two principal fronts, thus preventing that unity so essential to classic beauty.

The Union Bank, corner of Fenwick-street and Brunswick-street, has just been completed, and, although it is but a small edifice, I regard it as one of the completest, of its size, in the town. The front has two chaste Ionic columns, *in antis*, upon a high plinth, surmounted by a pediment, in which are some very bold and admirable carvings, whilst the frieze that surrounds the edifice is ornamented by handsome carvings of flowers, honeysuckles, &c. The cornice is plain and good, and is surmounted by carved pedestals and handsome parapets. Under the portico, also, are some very handsome illustrative carvings in high relief. The side is plain, but chaste, the windows simple and original, and all the details excellent.

After viewing these and many other buildings of the same kind, I inquired for the edifice in which the branch portion of the business of the Bank of England is transacted in this town, naturally expecting an edifice worthy of this great establishment, the profits it is reaping in the town, and the spirit shown in the erection of so expensive a one in London. But what was my astonishment and disappointment on being shown a poor, little, paltry, pitiable place, in Hanover-street, where there is neither beauty outside nor sufficient space in; some places dark, and all botched, inconvenient, and defective! Surely, the leviathan of Threadneedle-street will not be outdone by the pettiest banking-house in Liverpool.

A stranger is also justly struck by the number, size, and excellence of the Market-places here. The Fish Market is admirably suited to its purposes, and the entrance to the Fish Hall presents a very quiet, plain portico, expressive of its object. The St. John's Market, which is, I believe, the largest in this county, has no external beauty, as it consists, in front, of a mere brick wall, with stone entrance archway, with a column on each side and entablature over them. But, upon entering, one who has never been there before is much struck with the width, height, and length, the span and construction of the open roof, which, by constant repetition, as the eye looks down the long perspective of distance, has a curious effect. There are fine, broad avenues, supported and divided by numerous tall, slender pillars, to the eye all trending to the same point in the extreme distance, affording a beautiful practical illusion of perspective, whilst the admirable mode of lighting it gives, at certain times during the day, when the sun is brightly shining through the windows, an aerial effect of light and shade, and, in the distance, a dim atmospheric effect, that have been often admired by artists. All this, with the fair faces and rich dresses that are to be seen there, on market mornings; the luscious display of apricots, peaches, and other fruits; the beautiful bunches of flowers, of every kind, opening their petals to the day, and spreading around a delightful perfume; with the coolness and shadyness of the place, and the clean appearance of the market women, so different from those of Birmingham, London, or elsewhere, renders it, though but a market, a place where the stranger may well spend an hour's stroll.

EDER.

(To be continued.)

ON THE STYLE OF INIGO JONES.

We feel delight in reviewing the merits of a master, for as pupils of design we are interested in whatever concerns the history of our art: but we are more concerned in the criticism, when that master is an Englishman, and that art our country's. There is another interest involved in the investigation: because in descanting on style, we too often pass over beauties and originalities, where the prevailing sentiment is evidently borrowed. There is a disposition about us, to wave that patient investigation of the detail, under which the independance even of the borrower appears. Thus we say, in allusion to Inigo Jones, that his style is Palladio's. Certainly, there is the same modification of the orders, and the same appropriation of effect, perhaps the same selection of the parts. Certainly his style is Palladio's, if we except that, upon which the very groundwork of the Italian reposes: viz. the skill of assorting and applying, materials already furnished. But then he extracts no more from Palladio, than the poet does from nature, namely the elements and the matter. Indebted to Palladio he is, as the poet is to nature, for the picture displayed, but indebted he is also, to his own exquisite perception, for the soul which can encompass, and the hand which can pencil anew, its beauties in fresh combinations. He does not merely either leave Palladio full of the impressions of that master, but betrays the critic too: arrested by the elements, as much as by the effect by the parts, as much as by the whole. Such and such only, is the connection of the English master with the Italian: and if the latter deserve the homage of the southern school, so also does the former merit the praises of the northern. And if Palladio be recognized as the father of combinations, so should Jones be seen original in his conceits: whilst both appear like distinct geniuses of music: making the instrument of design to arrest the mind, solely by the exquisite beauty of their creations.

To follow Inigo Jones however in his arrangement, let us take him in one of his grandest flights, where the combinations are most extended, and the distribution most difficult. Suppose the front of 720 feet in the design for the Whitehall Palace. To distribute so long a front, and to bestow upon it the necessary gradations in effect, required several vast features in the first place: so the wings and the centre are made distinct, in plan, profile and elevation. The centre being the abode of dignity, and a focus for the eye, this is elevated above that contiguous to it: the wings too are elevated, and here the variety is first in the proportion, with the regulating principle an increase of the parts as they distance from the eye. For had not a tower terminated the façade, the eye would have fallen, and had not shadows been cast from the wings, tameness and indistinct blending might have resulted. Having resolved on general distinctions, Inigo Jones appears on a more intricate field, and here it is more important to follow him, since here it is he rises above, and surpasses his imitators.

First let us approach the centre, which though varying from others of his design, illustrates, the peculiar artifices of his style. It is not enough, be it observed, that the rusticated base which extends throughout, should here be stopped; and that pedestals and their huger columns should rise, unbroken by an inferior part to the first cornice. There is a fresh arrangement of variety yet to be considered. The centre betrays infinite attention and careful study. He seems here to have so diffused his features, that considered in itself and isolated from the main building, it would yet betray an unity in its design: unlike many of his followers who scatter their unity throughout the whole. Although the heighth of the centre is very little more than its width, the eye is yet insensibly led upwards to the tympanum which crowns it: and this not so much from the existence of that tympanum, as from the minutiæ. Nothing flat or depressed intrudes, the eye sweeps upon the arched entrance to the arched window above; and from the arched window to the figures which recline thereon. The angle made by those figures would meet in the base of the shield; whilst from the shield you at once forsake for the statue. Another glance however and fresh contrivances appear. The side compartments of the centre, in obedience to the idea of a pyramid which seems to float in Jones's mind, must not conduct you too hastily to the apex: because if so the principle of pyramidal truth would vanish. To avoid this error then, and yet still to admit of that gradual tapering, which in a pyramid is regular and unbroken, from the base to the summit: he has contrived in the side entrances, that their arches should conduct the eye, not to the tympanum, that would be sudden; but to the crown of the grand central arch: for if a line be drawn from the springing of the lesser arches to their crown: they would intersect in the crown of the greater arch. Then again, as if afraid that this were too sudden an ascent of line so near the base, he introduces two square panels over the lesser arches, as a relief to restore the balance, as it were of form. On the upper story the same idea exists, and the intersecting line of the lesser tympanums is in the centre of the head from which a festoon of flowers droop. A further scrutiny might still reveal increasing artifice in composition, but enough has been said for the merits of the centre. It will appear evident, I humbly believe as the criticism proceeds, that Jones surpasses all his imitators in that attention to the subordinate parts of his edifice. And this, be it remarked, is no trivial allowance to make, when the very elements and basis of Palladian doctrine, is combination; and that not in mere generalities, but in every part where consistency will admit a feature. Leaving the centre for the void, contiguous to it, there appears nothing peculiar to him from the rest of his school. The piers between the windows are twice the windows' width, whilst the windows are twice their height. The effect of this part, and its sober appearance is more to be considered in connection with the edifice as a whole, than as individually remarkable: except we notice the ornaments over each pier on the crowning blocking course: and which directing the eye upwards forms for it a kind of imaginary pyramid with each pier, whose ideal base is level with the top of the upper window. Advancing towards the wing, a part appears, contrasted with the void, from its heavy masonry, and then again relieved by its columns and statues. Here again the eye is courted centrally—(as if afraid that it might grow weary and fail) by its travel along the front. Four columns only are crowned with statues; the central window only have ballusters, whilst the roof slightly rises, to assist. Whilst here too the ornament, appears more abundant, and the superficies more enriched. The windows are richer, their dressings less plain. Trusses occur, breaks obtrude, and a ballustrade surmounts. Once more hasten on, and the wing salutes you, in its similarity to the centre, you admire the contrivance of Inigo Jones to protect the unity of this vast front. There you encounter a principle of optics though differently applied. The increased distance of the wing from the centre, exacts and increased importance in its composition, and proportionate to that distance, to recover the unity. It is made somewhat to resemble the centre, in its minutiæ, and thus the link of harmony is connected.

Looking back once more at the façade as a whole, we recognise a hand overcoming, rather than overcome by, the materials of his art. The perspective is also worthy of his notice, so that in whatever way you regard the edifice, its vast proportions and its more elegant reliefs are exposed to view. In the long and difficult front it is, that Inigo Jones is more marked and peculiar. That complication of parts, that ever varying distribution of the features, are peculiarly his. Others may appear on a smaller field equally happy, and yet cannot approach him in the grand and more extended scale. Like true genius he seems increasing in beauty and effect, with the increasing necessities; and extended nature of the design. As spectator of the structure, you are pleased as much by the intricacy unravelled as by the variety subdued. Nature with him is ever found under veil of art. But he is the painter of its gayer effects, whilst others on the contrary, represent its more sober appearances. If you take a critical survey of his designs you discover first the sketch, the outline and the shadows; and in this only *equal* to his school. But as a Watteau and Ostade gather a name from grouping the same figures, which otherwise exhibited were poor and tame, so Inigo Jones, by a consummate skill in assorting his, stamps his name upon the edifice. With the same cornice, architrave, ballustrade, figures and pediment, as others employ, a very different arrangement appears. If his front be short, you see this more particularly. He destroys the stiffness of outline by the detail. His decorations are sometimes sweeping and reclining in their form; and it was a desire to avoid the rigid line in ornament, that taught him to break the tympanum for the introduction of a wreath or a shield. If the wings are raised (which with him is usual when the centre is much depressed and the main body of the building long), he seeks to relieve, by a depression of form (very frequently) in the decoration. The architrave sometimes sweeps into width towards the base, as in the wing of Wilton House. He seldom employs one uniform unbroken ballustrade in the middle part, along the whole length, unless there has been a paucity of reliefs below. In Wilton House too we see this. If however the front be long, and the design a mansion, the various *parts* assume the varied forms, and together with the detail unite their effect: the various points of the building in this case assume an inclination in form as they soar up and encounter the sky. That is, they exhibit no harshness in their outline, or very little. He seems to unite with Wren in opinion and taste, and to mould the figures into spheres and sweeps as they stand against the sky. It is this which regulates him even in the ballustrade vases and globes that crown the cornice. It is something of this which directed a pediment on the wings of Wilton House, for it leads the eye in breadth, as a balance to the loftiness of the wing, and avoids the harshness of the horizontal. It may be admitted that this disrelish for harshness often led him into extravagance in composition, and caused him to exhibit in his smaller studies, a richness and exuberance more fitted for an interior. It may be admitted too that a certain want of severity in taste and coolness in adjustment, led him to trespass beyond what his more careful rival Burlington dared to allow. Often he may appear omitting the necessary members from a cornice, omitting the frieze, and introducing double plinths; still that richness of the artist, snatched from Italy is a charm entirely his own. In conclusion, it must be allowed, that Inigo Jones, gives a finish both picturesque and lively to the building, and brings into his design not only the orders and sentiment of Palladio, but the creations of an active fancy and the richest pictures of ideal taste.

FREDERICK EAST.

December, 1840.

ON THE RELATION OF HORSE POWER TO TONNAGE IN STEAM VESSELS.

SIR—It is a disputed question whether a large or small horse power of engines, is best adapted for sea-going steam vessels.

Without entering into the discussion, I will lay before your readers the tonnage and power of some of the finest ocean steam ships yet built; which table shows some curious contrarieties.

Vessels name.	Tonnage.	Horse Power	Proportion of tonnage to power.		Remarks.
				Tons.	
Acadia†	1200	440	1 h.p.	$2\frac{3}{4}$	Exceedingly fast.
Oriental	1670	440	1	4	$10\frac{1}{4}$ knots when deep.
Great Western	1340	450	1	3	
Great Liverpool	1543	464	1	$3\frac{1}{3}$	
British Queen	2016	500	1	4	Fast when light, and light stern breeze.
President	2366	540	1	$4\frac{1}{2}$	Slow under any circumstances
Liverpool (before alterations.)	1150	404	1	$2\frac{1}{2}$	Slow and crank.

In the above table I have endeavoured to place the vessels in the order of speed—an average westerly passage across the Atlantic being supposed to be the work performed. The "Oriental" and "Great Western" are, I think, about equal—as also the "President" and "Liverpool" (before alterations).

It will be observed that though the proportion is the same both in the "Oriental" and "British Queen," yet it cannot be questioned that on every point, and most especially when the vessels are deep, the "Oriental" has the advantage.

It may also be mentioned that the "Liverpool" has had seven feet more beam given her, and is now 393 tons larger than formerly; the proportion of power has, therefore, been *decreased*, whilst her speed and weatherly qualities have been materially *increased*.

Also, the four first and best vessels, and which vary least in their speed, in bad weather, have more beam (in proportion to their length) than the other three.

It appears to me that more depends on *the form and construction of the vessel*, than on having a large engine power.

I am, &c.

E.

Manchester, Nov. 30, 1840.

TABLE OF PORTICOES.

SIR—Mr. Dyer has pointed out what certainly looks like a very stupid blunder in the Table of Porticoes from the Penny Cyclopædia, and I was at first rather alarmed by his note, for he says that the portico of the Victoria Rooms is therein stated to have five intercolumniations (intercolumns), although placed in the octastyle class. But, on turning to the table itself, I find he has misconceived what is said in regard to that portico in the column of remarks, where it is further described as being "unequal diprostyle, recessed, five intercolumns," that is, recessed within for the space of five intercolumns, or corresponding with five out of the seven intercolumns of the octastyle in front. Perhaps the sense would have been clearer had the comma after "recessed," been omitted, or had "for" been substituted instead of it. But brevity was indispensable; and, in fact, that portion of the table was considerably abridged after being set up, in order to get rid of many *turn-overs*, and reduce it almost entirely to single lines. And thus it happened that the words "sculptured pediment," which were in the first proof, were struck out in order to save a second line. Other remarks underwent similar curtailment in several instances, for else the table would have occupied an entire page of the Cyclopædia. So far, however, from complaining of this, I rather feel grateful for so much space, and so many illustrative wood-cuts, being afforded me in that publication for such an article: because, although both fell far short of what I should have taken, had I been left entirely to myself, they exceeded what I could reasonably expect.

In these five vessels the variation of horses' power is only 24: the difference of tonnage 520!

† The remarks on the "Acadia" equally apply to her sister vessels, the "Britannia," "Caledonia," and "Columbia", and constitute a good example, as little difference is found in their performances, all the four being remarkably speedy vessels.

Mr. Leeds's note has afforded me an opportunity of explaining these circumstances, and accounting for, what I admit to be, undue brevity and obscurity in the column of remarks in the table. Whether he has seen only that portion of the article Portico in the Cyclopædia, I know not; neither do I know how he relishes the terms I have ventured to coin. Perhaps not at all: at least he has employed one term in a sense which I hold to be grossly solecistical and contrary to analogy, namely "*intercolumniations*," instead of "intercolumns": since the former term does not admit of a plural meaning, because it does not refer to the separate spaces or intervals between the columns, but merely the general arrangement, accordingly as the columns are put closer to, or further apart from each other. We therefore employ the first word very properly, when, with reference to that circumstance, we speak of the intercolumniation in a portico, &c., as being compact (*pycnostyle*), or straggling (*aræostyle*): but we should say "the centre *intercolumn* is wider than the rest;" or "there are seven *intercolumns*," and so on: for in such cases the other term is nonsense, and we might as well talk of a portico having eight or any other number of *columniations* instead of so many *columns*. Surely architects ought to know English well enough to feel the distinction at once; yet as a great many of them, it seems, do not, that must be my excuse for dwelling so long upon that little *lapsus linguæ*.

I remain, &c.,

L.

J. CROKER'S HINT TO THE SOCIETY OF BRITISH ARTISTS.

(In a Letter to the Editor.)

Sir—In noticing the Exhibitions at the Royal Academy, other publications besides your own have animadverted upon the very inadequate space there afforded to architectural drawings, in consequence of which, not only a great many are rejected every season, but of those admitted the majority are so hung up that they cannot possibly be examined, or even looked at all with any degree of comfort: accordingly those so placed are in danger of being altogether overlooked, let their merit be what it may. If the evil admits of no remedy nor mitigation—which, I for one, do not believe—complaint and remonstrance are of course useless. What surprises me, however, is to find that the Society of British Artists should not have had *nous* enough to take advantage of this circumstance, which they might easily enough convert to a trump card of their own. Surely it would be far better policy on their part, instead of entirely shutting up one of their rooms, as they have done for the two last seasons, to devote that room—which I should take to be quite as large as the one at the Academy—entirely to Architectural Drawings, and invite the profession (by public advertisement) to contribute designs. They might not perhaps be able to *fill* it—to get together such a *squeeze* of frames, as we invariably find in in the Architectural Room of the *Royalists*; yet that I conceive would be a very great recommendation rather than the contrary: and many—not the lowest of all in talent—would, it may be presumed, prefer the chance of a favourable situation in Suffolk-street, to the risk of being either turned out altogether from the building in Trafalgar-square, or else seeing their drawings hung up, where very few would be at the trouble of looking at them at all.

Nevertheless, I have been informed, upon most unquestionable authority, that the plan here suggested has been actually submitted to the council, by one of the members, and was thrown out almost *nem. con.* and without any *con*-sideration! Upon what grounds it is difficult to guess, for I believe no argument was attempted to be brought against it, except the most perverse and negative one, that it would do them—*i. e.* the painters—and their exhibition, no good whatever. Was there ever such grovelling, narrow-minded stupidity! Even granting that it would not render their exhibition more attractive, it could not possibly tend to make it less so. Those who did not care to look at such drawings would not be compelled to enter that particular room against their inclination. Neither would the addition of architectural drawings detract from their treasury: on the contrary, it might perhaps serve to draw a few more shillings into it. At all events the experiment would cost nothing—except, perhaps the printing one or two more pages in their catalogue,—and should it turn out quite a failure, they might then abandon the plan for the future. But until such proof be afforded, I will not believe that it would prove one: so far from it that I am of opinion the public generally would learn by degrees to take an interest in architectural designs and drawings by frequently seeing them: an opinion in which I am confirmed by a remark which Heinz makes in his notice of the architectural subjects at the Paris exhibition this year. After observing how desirable it is that the designs for all buildings of importance should be publicly exhibited beforehand: that considerable interest is thereby excited, and that critical remark and discussion are elicited, he continues thus: "It is idle to assert, by way of objection, that the public generally do not understand or relish architectural drawings: such argument will not hold water, when drawings of that kind are as beautifully executed as most of those in this exhibition. We had positive proof to the contrary, for we observed many even of the lower orders examining and apparently both understanding and gratified by them—even those which were sections. *Once afford the public the opportunity of seeing and becoming acquainted with architectural drawings, and they will very soon learn to understand them.*"

I make no further comment on this than to remark, that it is to be presumed the same might be the case here, unless, indeed it should be urged that English people are so very much more stupid than French people, that the latter country is no rule whatever for our own.—With respect to the British Artists and their enlightened Council, I leave them to chew the cud on what I have said. Neither I nor any one else can compel them to have common sense, if they are determined to have nothing to do with it. There is a saying which informs us that 'though one man can lead a horse to water, not ten men can make him drink;'—and so, I suppose, it must be with them: they will not swallow my prescription. Therefore, having sent you this epistle as a New Year's gift, I now take my leave, remaining,

Your's, with a Thousand Et-cæteras,

John Croker.

TABLES FOR RAILWAY CURVES.

Sir—Having heard much controversy between writers of scientific works, relative to the best mode of laying out segments of circles, whereby the prescribed limits of almost all lines of railway, render it, in the majority of cases, necessary to substitute curves of various radii; and I think several of your correspondents have not given the formula in a manner sufficiently comprehensive for general purposes. Having had frequent opportunities of determining curves upon several public works for some years, none yet appearstone so ably adapted, to all capacities, as the method you have set forth in the first number of your Journal for 1840, as to the accuracy of which I can testify, from having repeatedly put it into practice upon ground of no ordinary character.

I am, Sir,

Your obedient servant,

William Dodd.

Folkestone,
16th Dec., 1840.

Substitute for Tinning.—We have witnessed several interesting experiments calculated to test the success of an important discovery in the art of manufacturing cast-iron cooking vessels, by Messrs. T. and C. Clarke, the extensive iron-founders of Wolverhampton. English manufacturers of articles technically denominated "hollow ware," have for many years been sorely puzzled concerning an ingenious and beautiful method, practised in Germany, of lining iron culinary utensils with a smooth white enamel, resembling porcelain, which far surpasses, in point of cleanliness and durability, the English system of "tinning" the interior surface. Indeed, so desirable has this art been considered by our countrymen that, with their usual enterprise, considerable sums of money, and a most liberal expenditure of time and talent, have been for many years employed in seeking to discover the process. Until the present instance, however, every effort proved fruitless. Several of our manufacturers, it is true, have contrived to line the vessels with an enamel equal or superior in appearance to that of the foreign article: but this enamel cracked, chipped, and would not stand the fire; and the grand secret, which, of course, is the production of an enamel which shall so expand and contract with the metal as not to chip or crack, remained as much unknown as ever. Messrs. T. and C. Clarke, however, have at length most perfectly succeeded, and having, of course, secured a patent, are now manufacturing an article in every way superior to that of their Continental rivals. The manufacturers of British hollow ware have always surpassed those of Germany in the lightness and elegance of their castings, so that Messrs. Clarke are enabled to add this advantage to that of at least equal excellence of enamel. The German enamel is found to wear as long as the iron vessel itself, but we believe it will scarcely stand the severe test to which we have seen Messrs. Clarke's article subjected—viz., that of heating an enamelled saucepan to a white heat, and then plunging it suddenly into cold water, until cooled, without either the vessel cracking or the enamel being damaged or discoloured. Another experiment consisted in placing one of the vessels filled with water upon a large fire, and allowing it to remain until the water had completely boiled away, and for some minutes afterwards, without in the slightest degree injuring the vessel or its enamel. The great importance of the application of this discovery to our own manufactures is, that the hollow-ware manufactured in this country may be purchased at less than half the price of that imported from the Continent.—*Staffordshire Examiner.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

"On the Action of Steam as a Moving Power in the Cornish Single Pumping Engine." By Josiah Parkes, M. Inst. C. E.

(Continued from page 126, Vol. III.

Mr. Wickstead being called upon by the President, declined at present giving an opinion upon the theory before the meeting. He stated, that he was still trying experiments upon the engine at Old Ford—that the results up to the present time were in accordance with his anticipations—that, with small screenings of Newcastle coals, the duty of the engine amounted generally to 75 millions, and sometimes to as much as 81 or 82 millions. He thought that 7 lb. per square inch for friction and imperfect vacuum was too large an allowance for an engine of the size of that at Old Ford, as, when the speed was 10 or 11 strokes per minute, the power was equal to 200 horses, and, if an allowance of 6 or 7 lb. was made, it would be equal to 100 horses' extra power, which he felt certain could not be correct. At the same time, he believed that in very small engines the amount of friction, &c., might be correctly estimated at 6 or 7 lb. per square inch. He had also tried some experiments upon a Boulton and Watt low-pressure engine: by the introduction of Harvey and West's patent pump valves, the duty of the engine had been increased from about 28½ to 32½ millions. He was now trying experiments on clothing the cylinder, &c., and with steam in and out of the jacket: the result of all these experiments should be laid before the Institution as soon as they were completed.

Mr. Seaward considered the paper to be very valuable, as opening a new view of the action of steam, and inducing discussion and experiment; but he was not prepared to allow at once the percussive action, nor could he admit it to be the cause of the increased duty, as, if so, an augmentation of pressure in the boiler would give a corresponding increase of duty. Engines were worked at all pressures up to 60 lb., and even higher; but it was not perceived that the highest pressure gave the best results. He attributed the increase of duty to an improvement in the manner of using coal under the boilers; to the use of good non-conducting substances for clothing the cylinders, steam-pipes, &c., to prevent the radiation of heat; and to the general improvement in the construction of the valves and other parts of the engines, the proper dimensions for which were at present better defined. The expansive principle did not seem to have operated so well in the rotary as in the pumping engines. He had not hitherto credited the statements of engines working with a consumption of coal of 5 lb. per horse power per hour, nor of the great advantage of the use of steam at high pressures. Several Scotch boats had been worked with steam, at a pressure of 33 lb. on the inch, without any corresponding advantage. The increase of duty, then, he attributed to other reasons than the effects of percussion, as, independent of other considerations, the steam must always have possessed the same percussive force, which it must have exercised without producing the effects now attributed to it.

Mr. Wicksteed observed, that there were many reasons why the duty of the double expansive engines in Cornwall was not in proportion to that of the single pumping engines. The introduction of the former only dated from about the year 1834; but few had been made; there had not been the same amount of experience to guide the engineer in their construction; they were of small size, and consequently the amount of the friction was greater in proportion than in the large single pumping engines. Notwithstanding all these disadvantages, the duty had increased from 15 or 20 millions to 57 millions. It had been stated that the double expansive engines constructed by Hall and by Penn did not consume more than 5 lb. of coal per horse power per hour; while the ordinary low-pressure double engines required from 8 lb. to 10 lb. of coals. He would suggest to such members as possessed the power of verifying this fact to communicate their observations to the Institution.

Mr. Rendel would direct the attention of members to the main feature of Mr. Parkes's paper, which was the discovery of the action of a percussive force by the steam. The full investigation of this subject deeply interested the scientific world: and it was important that its merit should be clearly displayed. If any power could be gained from the percussive action, the more suddenly the steam could be admitted upon the piston, the more advantageous would be the result. It would be interesting to learn whether, in the changes in Cornish engines, from which such improved duty had resulted, any increased area had been given to the steam pipes and valves, and to what extent as compared with the old practice. If any change of this kind should be found to have taken place, it would be an argument in favour of the percussive principle.

Mr. Field expressed his sense of the obligations which the Institution owed to Mr. Parkes for having taken up this subject. It had been supposed by many persons that, independently of the economy arising from clothing the cylinder, jacket, and boilers, and the expansive action of the steam, some other cause might have assisted in producing the increase of effect in the Cornish engine. Doubtless, much had been done to economise heat and steam by the slow combustion of the fuel under the boilers, by diminishing radiation, and by expansive action. Nevertheless, the question to be solved was, Can these improvements account for the whole progressive advance in the duty from 40 or 50 to 90 millions? He trusted that Mr. Wicksteed would apply the indicator to ascertain [illegible] on the piston at every portion of the stroke.

Mr. Parkes remarked, that many persons [illegible] had [illegible] doubts of the sufficiency of the commonly-received theory of expansion to explain the excessive economy of the Cornish above the unexpansive engine. Some had recorded this opinion. Mr. Henwood found the steam's force in the Huel Towan engine unable to sustain the water-load alone. Messrs. [illegible] showed a similar deficiency of steam power in an engine at the United Mines; and Mr. G. H. Palmer was perfectly correct in his statement, that the absolute force of steam as commonly appreciated was inadequate to the performances assigned to it; but he was wrong in asserting that these effects had not been obtained, for they were indubitable.

As doubts had been expressed with regard to the accuracy and sufficient duration of the experiments selected as the basis of his analysis, he would state, that Mr. Henwood obtained the quantity of water consumed as steam, during a continuous observation of twenty-four hours, having previously measured the water discharged by a given number of strokes of the feed pumps, and then counting the entire number of strokes made to supply the boilers during the experiment. The pump was used periodically, and its whole contents injected into the boilers at each stroke, so that no material error could arise as to the quantity of water consumed as steam. With respect to the resistance overcome, Mr. Henwood several times measured the whole height of the lifts in the most careful manner, not comprehending the fact of the steam's force being unequal to sustain the load of water alone. Not content with this, he measured the water discharged by the pumps, and found a near correspondence with the calculated quantity.

Mr. Parkes would prefer a short experiment on the consumption of water as steam to a long one, as more likely to be accurate. He had rejected the eight months' experiment on the United Mines engine, as being unsuitable for the purpose of his investigation; for, during so long a period, the boilers must have been several times emptied and cleaned, stoppages must have occurred, condensation, leakage, and other circumstances must also have taken place, which unfitted that experiment for analysis. Long experiments were the best for the practical determination of the duty done by coal; but the action of steam in performing that duty was altogether a separate consideration. The consumption of water as steam for a single stroke of the engine, if it could be obtained, would be all-sufficient for investigating its action in the cylinder, as the weight raised by a Cornish engine must be the same at every stroke. If any error existed in the statement of the wated evaporated, it was more likely to be in excess than in deficiency; for it would be admitted that the conversion of 10½ lb. of water into steam, by 1 lb. of coal was not a common occurrence. Yet, granting this result to have been obtained, it appeared that there was not steam enough to overcome the resistance. Such was the result of the analysis of the Huel Towan and Fowey Consols engines, for which the evaporation was ascertained; and if less water had been converted into steam, the deficiency of power, compared with the effect, would necessarily have been still greater. Mr. Henwood's statement of the performance of the Huel Towan engine was confirmed by a previous trial of the same engine in 1828, conducted by a committee of twenty-one competent persons, when it appeared, after twenty-six hours' experiments, that 87,209,662 lb. had been raised one foot by a bushel of coals. Mr. Henwood's experiment gave 81,398,900 lb., so that in the analysis the lowest result was used.

It had been urged, that if any such force as percussion belonged to steam now, it always formed one of its properties. This was true; but it either may not have been well applied, or its effect not detected. The expenditure of power as derived from the quantity of water consumed as steam could not be determined so long as any condensation of steam took place in the cylinder; for whatever steam was there condensed had lost its power. The perfect clothing of the Cornish cylinders rendered the analysis of the action derived from a given quantity of water as steam nearly free from error.

Mr. Wicksteed had stated, that when he kept the steam out of the jacket of one of Boulton and Watt's engines, it required full steam throughout the stroke to overcome the load; whereas, with steam in the jacket, some expansion could be used. This would show a greater expenditure of power in one case to produce an equal effect. Such, however, could not be: an equal power operated in both cases; but in the one, a portion of it was annihilated, or had produced no useful effect.

Mr. Parkes considered it as demonstrated, that a force, independent of the steam's simple elastic force within the cylinder, did operate in the Cornish engines. The term *percussion* might be objected to when applied to an elastic fluid. Nevertheless, he conceived that the instantaneous action transmitted to the piston, on the sudden and free communication effected between the cylinder and boiler, must produce an effect analogous to the percussion of solids. He considered the proofs of such action adduced in his paper as irresistible.

He would ask how it could be accounted for that the steam was in a state of expansion during 19 out of 20 parts of the stroke in the Huel Towan engine, as shown by the indicator diagram, though it was freely admitted during one-fifth of the stroke, unless a velocity had been given to the piston by an initial force exceeding that of the steam's simple elastic force? How was it that, at the end of the stroke, the steam's elasticity was able to sustain so small a portion of the load in equilibrio, unless a momentum had been transferred to the mass by the impact on the piston, and aided the expanding steam to complete the stroke, which alone it was incompetent to perform?

larger degree of attenuation in which the steam was found on the completion of the stroke in one engine than in another, compared with the pressure of the resistance, and with the amount of expansion determined by the period of closing the valve, alone proved that the ordinary theory was inadequate to explain the action of steam in these engines.

He had for some time conjectured that a hidden and unsuspected cause influenced the performance of the Cornish engine; and if he had not been successful in discovering its nature, he considered the analysis as placing the fact beyond question, that the quantity of action resulting from the steam admitted into the cylinder was much below the force of the resistance opposed to it, and overcome.

June 23.—The President in the Chair.

John Frederick Bateman was balloted for and elected a member.

"*On the Stamping Engines in Cornwall.*" By John Samuel Enys, A. Inst. C. E.

The process of stamping or reducing the ores of tin in Cornwall, by means of iron stamp-heads, which crush the ore in falling upon it, was formerly effected in mills worked by water power. These have been, from economical and other reasons, for the most part superseded by the use of steam; and even with inferior engines, the result has been such as to enable the poorer portions of the lode (which were frequently left in the mine) to be now advantageously worked.

The work performed by the stamping engines was reported with that of the pumping engines, and showed the duty to be from 16 to 25 million lb. raised one foot high by one bushel of coal, as estimated from the actual weight of the stamp-heads. The engines appropriated for this purpose were generally old double-acting engines of inferior character, and not unfrequently in a bad state of repair. The use of expansive steam was tried with good effect upon them, and induced Mr. James Sims to build an engine calculated more fully to develop the advantages of this principle. He accordingly, in the year 1835, erected one at the Charlestown mines. It was a single-acting engine, communicating the movement direct to the cam shaft for lifting the stampers without the intervention of wheel-work. The first reported duty, in December, 1835, was 43 millions, which was two-fifths more than had previously been performed by stamping engines. Subsequently, Mr. Sims erected other engines of similar construction, and from them may be taken the reported duty in April, 1840:—

Charlestown Mines . . .	59,589,884 lb.
Carn Brae . . .	57,611,073
Wheal Ketley . . .	58,718,452

This increased duty induced other engineers to turn their attention to the subject, and they have constructed engines which equal these duties; the chief variation being the adoption of double action, which seems generally to be preferred.

This paper is accompanied by four drawings of the Carn Brae stamping engine, by Mr. Sims, junior, showing in great detail the construction of the engine and the stamping machinery.

"*On the Effects of the Worm on Kyanized Timber exposed to the action of Sea Water, and on the use of Greenheart Timber from Demerara, in the same situations.*" By J. B. Hartley, M. Inst. C.E.

There are probably few ports in England where the inconvenience resulting from the attacks of marine worms (*Teredo navalis*) on the timber of the dock gates and other works exposed to their action, is more severely felt than at Liverpool. The river Mersey has a vertical rise of tide of 27 feet at spring, and 13 feet at neap tides, and the stream being densely charged with silt, a considerable deposit takes place in the open basins, and to some extent in the docks. The latter are cleansed by means of a dredging machine, but the former are usually "scuttled," for which purpose sewers connected with the docks surround the basins, having several openings furnished with "clows," or paddles, so that the rush of water from the docks may be applied for clearing away the mud from any particular part of the basin. The security of these paddles is, therefore, of the greatest importance, as the failure of one of them might, by allowing a dock to be suddenly emptied, cause great damage to the shipping. These paddles have been usually constructed of English oak or elm, and being much exposed, they suffer from the attacks of the worms. Cast iron paddles have been tried; but in consequence of the rapidity of the corrosive action, they soon became leaky, and were abandoned. Kyanized oak timber has been tried on the back of these paddles, and found to be perforated by the worm in the same time as unprepared wood. Some oak planks, two inches and a half thick, Kyanized at the Company's yard, were used on the west entrance gates of the Clarence Half-tide Basin, and in 14 months were completely destroyed. Several similar instances of the non-efficiency of the Kyanized timber are given; and the author proceeds to designate the timber which resists best in such situations. He considers that teak is less liable to injury than English woods, and instances the inner gates of the Clarence dock, which have been built for 10 years, and at present are but slightly attacked.

The timber which he prefers for dock works is the Greenheart. It is imported from Demerara, in logs of 12 to 16 inches square by 25 to 40 feet long, and costs about seven shillings per cubic foot. Of its power to resist the attacks of worms, he gives many proofs: one of them may be cited. At the first construction of the Brunswick Half-tide basin, several elm clows were placed at the west entrance: these were destroyed by the worms in two years, and were replaced by others made of greenheart, the joints of the plank being tongued with deal, to render them completely water-tight. These clows have now been down about seven years, and, although the deal tongueing has been destroyed by the worms, the greenheart planking remains untouched and perfectly sound.

Many methods of protecting common timber have been tried, but the only successful ones adduced are—1st, the use of broad-headed metallic nails driven nearly close to each other into the heads and heels of the gates, but if driven an inch apart, the worm penetrates between them; and 2ndly, steeping the timber in a strong solution of sulphate of copper from the Parys copper mines in Anglesea. Some paddles made of English elm thus prepared had been in use upwards of three years, and, on an examination, were found to be very slightly injured; while the unprepared timber about them was quite destroyed.

The author observes, that the outer gates of the wet basins are most injured by the worm, from the sills being low down, and the change of water every tide assisting the growth of the worm. Those parts of the gates which are alternately wet and dry are more injured by the worm than the parts immersed always in the same depth of water. At the spot where a leak occurs from a bad joint, a defect in the caulking, or other cause, the worm commences its attack; so that the most incessant attention is required. Those basins into which the sewers of the town discharge themselves are comparatively free from the worm, from which it would appear that sulphuretted hydrogen gas acts in some measure as a protection against the attacks of the worm.

"*An account of the actual state of the Works at the Thames Tunnel, June 23, 1840.*" By M. I. Brunel, M. Inst. C. E.

In consequence of local opposition, the works have not advanced much since the month of March, 1840; but, as that has been overcome, and facilities granted by the city, the works will be speedily resumed, and the shaft on the north bank commenced.

The progress of the Tunnel in the last year has been, within one foot, equal to that made in the three preceding years. During those periods collectively, the extent of the Tunnel excavated was 250 ft. 6 in., and during the last year the excavation has been 249 ft. 6 in. This progress has been made in spite of the difficulties caused by the frequent depressions of the bed of the river. These have been so extensive, that in the course of 28 lineal feet of Tunnel, the quantity of ground thrown upon the bed of the river, to make up for the displacement, in the deepest part of the stream, has been *ten times* that of the excavation, although the space of the excavation itself is completely replaced by the brick structure. On one occasion the ground subsided, in the course of a few minutes, to the extent of 13 feet in depth over an area of 30 feet in diameter, without causing any increased influx of water to the works of the Tunnel. The results now recorded confirm Mr. Brunel in his opinion of the efficiency of his original plan, which is "to press equally against the ground all over the area of the face, whatever may be the nature of the ground through which the excavation is being carried." The sides and top are naturally protected; but the face depends wholly for support upon the poling boards and screws. The displacement of one board by the pressure of the ground might be attended with disastrous consequences: no deviation therefore from the safe plan should be permitted.

The paper is accompanied by a plan, showing the progress made at different periods. It is stated that a full and complete record of all the occurrences which have taken place during the progress has been kept, so as to supply information to enable others to avert many of the difficulties encountered by Mr. Brunel in this bold yet successful undertaking.

June 30.—Henry Robinson Palmer, V.P., in the Chair.

"*Description of an Instrument for describing the Profile of Roads.*" By Henry Chapman, G. Inst. C. E.

The object of the author in the invention of this instrument was to facilitate the mode of making a preliminary survey for railways by a machine of a simple construction, and composed of very few moving parts. It may be thus briefly described:—

A light frame with springs and upon four wheels carries the machinery, to which a rotary movement is communicated from one of the wheels, which is keyed fast upon its axle. A double-threaded screw and a series of wheels work give motion to a cylinder, upon which a length of paper is coiled; this cylinder revolves, and moves simultaneously in the direction of its axis. A pencil, which moves parallel to the axis of the cylinder, marks a line upon it, with a velocity varying according to the inclination of the road, and is so arranged, that when the machine is passing along a level, the motion of the pencil will equal that of the cylinder. In ascending inclined planes, it will be retarded, and in descending it will be accelerated. By these means a rising or falling line will be accurately drawn. This variation in the action of the pencil is accomplished by means of a friction-wheel working against a cone, the different diameters of which regulate and determine the speed. The position of the friction-wheel upon the cone is determined by the change of position of a pendulum vibrating within a case which is filled with a dense fluid, for the purpose of rendering its action more uniform.

The machine will trace a section of a road in lengths of five miles upon each sheet of paper, to a horizontal scale of 20 chains per mile, and to a vertical scale of 200 feet to an inch. That no inconvenience may be felt from the smallness of the scale, the instrument is furnished with scales with sliding verniers, from which memoranda can be made of the distance run, and of the variations above or below the datum line. These memoranda are made upon a strip of paper, which is fastened on a table, along which an index travels at a velocity corresponding with that of the paper on the cylinder; so that the strip of paper being afterwards laid upon the section, the points marked may be squared down without using the scales.

When the distance of five miles is passed over, a bell gives notice of the working machinery being disengaged: the section is removed, a fresh sheet of paper is introduced, and, as the pencil maintains its position, the section will be carried on continuously.

This communication is accompanied by three working drawings, showing, on a large scale, the machine in action, and all the component parts in great detail.

"*On the Efflux of Gaseous Fluids under pressure.*" By Charles Hood, F.R.A.S., &c.

The theoretical determination of the velocity with which gaseous fluids are discharged through tubes and apertures, has frequently been investigated by mathematicians: and as the question is one of importance in various branches of practical science, the author examines the several theorems which have been proposed for its elucidation, and compares them with the results obtained by experimental researches.

Dr. Papin, in 1686, appears to have first ascertained the law of efflux to be the same for both elastic and inelastic fluids, and the majority of the writers on the subject since his time have adopted as the fundamental *data* of their calculations, the hydrodynamic law of spouting fluids, by which the velocity of discharge is found to be proportional to the square root of the height of the superincumbent column of homogeneous fluid.

The author investigates particularly the methods of calculation proposed by Dr. Gregory, Mr. Davies Gilbert, Mr. Sylvester, Mr. Tredgold, and M. Montgolfier, and points out the differences which exist in their several methods. That of Mr. Sylvester is the only one which differs in any considerable degree from the simple law above stated; and his calculation is based upon the supposition that the respective columns of light and heavy air represent two unequal weights suspended by a cord, hanging over a pulley—by which mode of calculation, in the cases selected by the author for comparison, a result is obtained of only about one-third the amount given by the other methods. These calculations are compared with some experiments made by Sir John Guest at the Dowlais Iron Works, and also of Mr. Dufrenoy at the Clyde and at the Butterly Iron Works, recorded by him in his report to the Director-General of Mines in France. The results are tabulated; giving the pressure of the blast, the area of discharge, the velocity of the blast, the quantity of air ascertained by experiment, and the quantity shown by the several methods of calculation. From all these comparisons the author draws the conclusion that the method of calculation proposed by Montgolfier is the most accurate' as it is also the most simple. If the pressure be ascertained in inches of mercury, it is only necessary to find the column of air in feet equivalent to the pressure, and to multiply this number (as in the common case of gravitating bodies) by 64 feet, and then the square root of this product will give the velocity of discharge in feet per second. The equivalent height of the column of air in feet is found by multiplying the number of inches of mercury by 11,230 and dividing the product by 12, mercury being 11,230 times the weight of air. Allowing for a small loss by friction in the quantity found by experiment, the agreement between the theoretical and experimental quantities is extremely near. Rules are likewise given for applying these calculations to other gases of different specific gravities, which are also applicable to chimney draughts and to the expansion of air by heat.

End of Session 1840.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Tenth Meeting.—*September*, 1840.

(From the Athenæum.)

Section G.—Mechanical Science.

"*On certain Improvements on Locomotive and other Engine Boilers.*" By Mr. Hawthorn.

The object of this improvement is to prevent what is technically called "priming," to heat the steam on its passage to the cylinder, and to employ return tubes, as well as direct tubes, for heating the water. The advantages are said to be, that no water is carried with the steam into the cylinder, and a saving of fuel, through the arrangement of the tubes, from 30 to 40 per cent.

Mr. Scott Russell observed, that the plan of surcharging steam was much used in America. They work the steam expansively. Mr. Russell thought the *dome* shape in the fire-box inferior to the *flat staged* box, and was afraid that the steam, returning from the cylinder through the boiler, would merely abstract and not communicate heat.

"*On the Fan-blast as applied to Furnaces.*" By Mr. Fairbairn.

In explaining the methods to be pursued in adapting furnaces to the fan-blast, Mr. Fairbairn observed that it was well known that its application to the cupola for melting pig iron was attended with the most complete success, and the object of the present inquiry was to determine how far the same mode of blowing was applicable to furnaces on a large scale, for the purpose of smelting ores. Objections had been made to Mr. Fairbairn's plan, on account of the very low pressure at which the air is introduced into the furnace, and its insufficiency to force it through a mass of material such as is contained in the furnaces of this country, and which is from 30 to 40 feet in depth. To these objections Mr. Fairbairn replied, that the same had been urged against the introduction of the fan-blast to the cupola: that, in his opinion its efficiency was as the quantity discharged, and not the pressure, which regulated the passage of the air from the "twyres" to the top of the furnace. The fan-blast, when supplied with large apertures into the furnace, would, in his opinion, increase the process of calcination, effect a more equable temperature, and produce a superior quality of metal. It appeared, therefore, of importance that the experiment should be made, and Mr. Fairbairn offered to superintend its introduction, provided the proprietors of the numerous works in this country agreed with him in opinion, that the process would be advantageous both as regards expense, and the improved quality of the metal produced.

Mr. Smith thought the plan well worthy of being tried. It is not the *force* of the blast that is necessary, but the *quantity of air* introduced. In a cupola in which the blast is given by the fan, the iron is brought down in half the time that was necessary with the cylinder blast. Mr. Smith has no doubt of the success of the fan-blast in smelting furnaces, the heat being more uniform.

"*On Propelling Boats on Canals.*" By Mr. Smith.

Mr. Smith proposed that the steam power in the boat should drive two large wheels, of thirty feet diameter, which should bite the ground at the bottom of the canal. He exhibited a working model on this principle, which succeeded on the small scale; and he stated that he had tried it on a larger scale with the power of four men, and it had also succeeded. The wheels might be either on each side of the boat, as in the model, with a provision for a play of three or four feet, that they might accommodate themselves to inequalities at the bottom of the canal; or there might be one wheel in the centre of the boat, if constructed on the twin principle.

Mr. Scott Russell was not sanguine as to the success of this plan. The wheels must be made very heavy, in order to give the propelling power, and their weight would have an injurious effect at the bottom of the canal. A large steam boat would be necessary in order to get sufficient power, and if this large vessel were propelled at high velocities, the surge from the bows would be very great, and the stern would drag in the water.—Mr. Smith said, that he had confidence in the plan, notwithstanding the objections raised, and intended to try it on a large scale, and would report next year to the Association the results, whether favourable or otherwise.—Mr. Glynn remarked, that an attempt was made some years ago by Mr. Seaward, to propel boats on canals by means of wheels composed of two rims, with steps between them as a ladder, running on the bottom of the canal; but it was abandoned.

"*On a New Rain Gauge.*" By Mr. James Johnston, of Greenock.

Mr. Johnston described a new rain gauge, so constructed that the receiving funnel or orifice at which the rain enters, is always kept at right angles to the falling rain. By the action of the wind on a large vane, the whole gauge is turned round on a pivot, until the front of the gauge faces the quarter from whence the wind blows: and by the action of the wind on another vane attached to the receiving funnel, the mouth of the funnel is moved from a horizontal towards a perpendicular position according to the strength of the wind. The receiving funnel and vane attached to it are balanced with counterpoise weights, in such a manner that the wind, in moving them, has as much weight to remove from a perpendicular position, in proportion to their bulk, as it has when moving an ordinary sized drop of rain from the same position; by this means the mouth of the gauge is kept at right angles to the falling rain.

Mr. Milne gave an account of a High Pressure Filter for Domestic Purposes.—Mr. Thom stated, that from experience he found it was better to filter *downwards* than upwards.—Mr. Hawkins agreed with Mr. Thom, that filtration downwards is superior to filtration upwards; he preferred charcoal to sand for filtering, and preferred filtering without high pressure.

Mr. Dunn explained Ponton's Electro-Magnetic Telegraph, which instrument was exhibited in the model room.

Mr. Fairbairn described Hall's Patent Hadraulic Belt for Raising Water.

M. le Comte de Lille explained his method of laying down Wood Pavement, as exemplified at Whitehall.

The Rev. Dr. Paterson gave an account of an *Improved Life Boat*, which he called a Riddle Life Boat, because the bottom is like a riddle. The sides of the boat consist each of a hollow elliptical tube, to be made of sheet-iron, and from this it has all its buoyancy, which is unaffected by any influx of water. This boat, he said, was light, easily propelled, and drew only a foot or two of water; and besides being used for reaching vessels in distress, or carrying passengers to steam boats, it might be itself carried as a ship's boat—to be ready for use in danger, or difficult landing.

Mr. Williams stated, that this boat seemed to be original, and that he (Mr. Williams) would make a trial of it on a large scale.—Mr. Vignoles thought it might be usefully employed for pontoons.

"*On an Improved Rain Gauge.*" By Mr. Thom.

It consists of a cylinder two feet long, and seven inches diameter, sunk in [illegible] the mouth of it [illegible] receive the [illegible] water, the gauge [illegible] cylinder is put a float, with a scale or graduated rod attached to it, which will move up or down as the water rises or falls in the cylinder. There is a thin brass bar fixed within the funnel, about half an inch under its mouth, with an aperture in the middle just large enough to allow the scale to move easily through it. The upper side of this cross bar is brought to a fine edge, so as to cut but not obstruct the drops which may alight on it. There is an aperture also in the bottom of the funnel, through which the water must pass into the cylinder, and through which also the scale must move; but this aperture requires to be made no larger than just to permit the scale to move through it freely. When the gauge is firmly fixed, and the float and funnel in their places, water is to be poured in till the zero of the scale is level with the upper edge of the aperture.

Mr. Thom gave an account of the water filters used at Greenock and Paisley. A species of trap rock or amygdaloid, common in the neighbourhood, is broken to the size of small peas, and mixed with fine sharp sand. The water is filtered by passing directly downwards through the media, which media are in their turn cleansed by passing the water through them upwards. The filter does best at two feet of pressure and under.

"*Description of a Revolving Balance.*" By Mr. Lothian.

The opposing arms of this balance are curved, being formed of two spirals, the one situated vertically over the other, and both bending round a common centre of movement, which is placed in the pole of the upper curve. The spirals diverge from each other near their origin, but approach and merge together at their extremes, and thus form one continuous curve, which is grooved on its circumference. The cords or chains which suspend the receiving scale and counterpoise act against each other in this groove—the weight of the scale, when hanging from a lengthened radiant of the upper spiral, being in equilibrio with the greater weight of the counterpoise when hanging from a shorter radiant of the lower one. When this state of rest is disturbed by loading the scale, the balance moves round, and, in the progress of its revolution, the opposite eccentricities of the spirals combine in changing the ratio of the leverage, and thus originate a self-adjusting power, by which the loads of both cords are mutually moved into equilibrium. The receiving scale thus commences with greater, and ends with less mechanical power than the counterpoise—a circumstance which is in harmony with the purpose of employing an unchanging weight to measure others both less and greater than itself; while the principle is one which concentrates the power and abridges the size of the machine. In order, however, that the total amount of adjusting power thus generally obtained may be equally drawn upon and advantageously distributed throughout the movement of the balance, a definite relation is established between the weight of the counterpoise and the rates at which the accumulating weight of the scale and the leverage of the lower spiral increase. The leverage of the upper spiral, being derived from these ascertained conditions, is made to preserve a rate of decrease which accords with the previously regulated increase in the leverage of the lower curve; while both spirals have their precise form determined by the additional consideration of the direction in which the cords exert their power on the circumference of the balance. In their calculated formation, the two spirals are thus dependent on and related to each other, while together they are component parts of one continuous curve, in which the mutual and combined changes of leverage are made to follow an equable, as well as a general progressive gradation; by which means, the balance is moved through equal angles by equal weights. In machines intended for weights of considerable amount, the balance is made to revolve about an axis, which is itself supported, a little above its centre, on knife-edge rests, so as to combine the movement of the revolving balance with the libration of the common one—the coincidence of a pointer from the axis with the ordinary pointer of the machine showing when the indication is practically unaffected by friction. In machines for weights of still greater magnitude, the articles to be weighed are made to act, in part, as their own counterpoise, by adopting differential curves to diminish the descending power of the scale; by which a comparatively small counterpoise is made to adjust the unsupported difference of weights greatly exceeding itself.

"*On the Combustion of Coal and the prevention of the generation of Smoke in Furnaces.*" By Mr. Williams.

Mr. Williams observed, that in treating on steam and the steam-engine, the subject divides itself into the following heads:—1st, The management of *fuel* in the generation of *heat*; 2nd, The management of *heat* in the generation of *steam*; 3rd, The management of *steam* in the generation of *fuel*. The first belongs to the *furnace*; the second to the *boiler*; and the third to the *engine*. The first, although exclusively in the department of chemistry, is to be considered in the Mechanical Section, for the purpose of showing its connexion with the practical combustion of fuel in the furnace. The main constituents of coal are carbon and bitumen: the former is convertible, in the *solid* state, to the purpose of generating heat: the latter, in the *gaseous* state alone, and to this latter is referable all that assumes the character of *flame*. The greater part of the practicable economy in the use of coal being connected with the combustion of the gases, this division of the subject is peculiarly important. We all know that combustible bodies cannot burn without air: the actual part, however, which air has to act is little inquired into beyond the laboratory: yet on this part depends the whole of effective combustion. Having explained the nature of combustion, Mr. Williams went on to show, that all depended on bringing the combustible and the air into contact in the proper quantities, of the proper quality, and at the proper time—the proper place, and the proper temperature. The conditions requiring attention were, 1st. The quantity; 2nd, The quality of the air admitted; 3rd, The effecting their incorporation or diffusion; 4th, The time required for the diffusion; and, 5th, The place in the furnace where this should take place. Mr. Williams exhibited several diagrams, representing the several processes connected with the combustion of a single atom of coal-gas or carburetted hydrogen, and also of bodies or masses of such gas. The essential difference between the ordinary combustion of this gas in combination with atmospheric air, and that resorted to by Mr. Gurney in combination with pure oxygen, in what is called the Bude light, was then explained. By these diagrams, it was shown, 1st, What was the precise quantity of air which the combustion of gas demanded; 2nd, The degree or kind of mixture which combustion required; and, 3rd, That the unavoidable want of time in the furnace to effect this degree of diffusion was the main impediment to perfect combustion, and the cause of the generation of smoke. From the consideration of these details, the inference followed, that smoke once generated in the furnace cannot be burned,—that, in fact, smoke thus once generated became a new fuel, demanding all the conditions of other fuels. Mr. Williams dwelt much on the chemical error of supposing that smoke or gas can be consumed by bringing it into contact or connexion with a mass of incandescent fuel on the bars of a furnace: that, in fact, this imaginary point of incandescence, or the contact with any combustible body at the temperature of incandescence, was peculiarly to be avoided, instead of being, as hitherto, sought for; and hence the failure of all those efforts to prevent or consume smoke. The great evil, then, of the present furnaces was their construction, which did not admit the necessary extent of time (or its equivalent), time being essential to effect the perfect diffusion of mixture of the gas, of which every chemist knew the importance, and on which the experiments of Prof. Graham were so conclusive. Mr. Williams then proceeded to show, that unless some compensating power or means be obtained, and practically and economically applied, we can never arrive at full combustion, or prevent the formation of smoke. This compensating power was shown to be obtainable by means of surface, and was well exemplified in the blow-pipe: the remedy then, for the want of time in the furnaces, may be met, by introducing the air in the most effective situation, by means of numerous small jets. Mr. Williams submitted the primary law to be this; viz., that no larger portions of air, that is, no greater number of atoms of air, should be introduced into any one locality, than can be absorbed and chemically combined with the atoms of the gas with which they respectively come into contact. Again, that the effecting, by means of this extended surface, this necessary diffusion was the main condition which required attention, and not that of temperature. Mr. Williams then exhibited the diagram of a boiler to be constructed on the above principles, and stated that he had an experimental boiler at work, which fully proved the accuracy of the principle.

Sir John Robison stated, that the Committee of Recommendations had suggested the appointment of a Committee to make a further investigation, and report to the Association at their next meeting.—Mr. Vignoles observed, that the gradual increase of the aperture for the blast of cupolas for second meltings of metal, the areas of which were now at least fifty times larger than formerly, proved the necessity of admitting large quantities of oxygen in combustion, which could only be obtained in its combination with the nitrogen, the other component part of atmospheric air.

"*On the Temperature of the Earth in the deep Mines in the neighbourhood of Manchester.*" By Mr. Eaton Hodgkinson.

Mr. Hodgkinson having, some years ago, received from Prof. Phillips four thermometers belonging to the Association, got, through the kindness of the proprietors of the following pits, and other parties connected with them, experiments made upon the temperature of the earth in each of them:—The salt-rock pit, 112 yards deep, belonging to the Marston Salt Company, near Northwich, Cheshire; the Haydock Colliery, 201 yards deep, near to Warrington; the Broad Oak Coal-mine, 329 yards deep, near to Oldham. In the latter pit, a thermometer placed in a hole three feet deep, bored in "metal," and closed at the aperture, was examined weekly by Mr. Swain for twelve months, the temperature varying from 57° to 58½° Fahr.—it being lowest from the beginning of February to the middle of May, and highest in September and October to the middle of November. The experiments above mentioned were made in 1837 and 1838, and the results mentioned at the Birmingham meeting; but the Broad Oak pit having been increased in depth since that time, a thermometer was inserted in it, in a hole bored in metal, as before. It was in a place 408 yards deep, and indicated a temperature of 61°, remaining nearly constant for twelve months. Mr. Fitzgerald being recently engaged in sinking a deep coal-pit at Pendleton, two miles from Manchester, Mr. Hodgkinson conceived this to be a favourable opportunity for getting additional information on the subject of subterranean temperature, and, on his application to the proprietor, the engineer (Mr. Ray) readily made for him, during the sinking of the pit, and afterwards in the workings, the experiments of which the results are below. At 418 yards from the surface, the temperature, in a hole from three to four feet deep, bored in dry rock, was 66°; at 450 yards deep it was 67°; and at 480 yards it was 69°. In the workings at 461 and 471 yards deep, it was in both cases 65°. The mean temperature of the air at Manchester, according to Dr. Dalton's experiments, is 48° Fahr.; and, as the pits above mentioned are not very far from Manchester, the mean temperature of the earth at the surface of each of them may be considered as 48°. With that supposition, the distance sunk for each degree of Fahrenheit would be as below:—

In the rock pit	32 yards.		
Haydock coal pit	20 „		
Broad Oak pit	33·7, 31·4	32·5 „	= mean.
Pendleton pit (shaft)	23·2, 23·7, 22·8	23·2 „	= mean.
Ditto (in workings)	27·1, 27·7	27·4 „	= mean.

The mean from the whole being 27 yards for each degree of temperature.

The President remarked, that Mr. Hodgkinson's results gave the rate of increase of temperature greater near the surface, and then decreasing, which did not agree with the results of other observers: this, he conceived, arose from nearly the same cause as that already remarked upon when Mr. Fox's report was under consideration. Mr. Hodgkinson commenced to reckon his descents or depths, not from the surface, but from the plane of invariable temperature, which in these latitudes was not far from 60 feet.—Prof. Forbes illustrated simply by a diagram how this caused the rate of increase at first to be too high, and then to diminish. He then alluded to the frozen soil of Siberia, gave a description of it, and said, that it had been sunk through to a depth of 382 feet without being penetrated—that is, without reaching a temperature of 32°, although the temperature of the surface was not below 18°. In this case, the rate of increase was rapid.

"*On the Temperature and Conducting Power of different Strata.*" Prof. Forbes's Report.

In this report, he wished to give the results of the observations made at Edinburgh during the year 1839, upon thermometers sunk at depths of 3, 6, 12, and 24 French feet into trap rock, pure loose sand, and sandstone. The details for the years 1837 and 1838 were already laid before the British Association at Birmingham. In order to render the report of the results for 1839 intelligible, Prof. Forbes went over nearly the same explanatory matter as that which is already published in the report referred to. He then exhibited the curves derived from the three years' observations, remarked upon their wonderful agreement, and gave, in a tabular form, the results for the three years, which were as follows:

Values of A (A being the constant in the formula given in the report referred to).

	In trap.	In sand.	In sandstone.
For 1837	1·164	1·176	1·076
1838	1·173	1·217	1·114
1839	1·086	1·182	1·049

Values of B (the other constant).

	In trap.	In sand.	In sandstone.
For 1837	·0545	·0440	·0316
1838	·0641	·0517	·0345
1839	·0516	·0498	·0305

Variation reduced to 0·01° Centigrade.

	In trap.	In sand.	In sandstone.
For 1837	58.1 feet	72·2 feet	27·3 feet.
1838	49·3	61·8	91
1839	59·2	63·5	100

Velocity of propagation for one foot of depth.

	In trap.	In sand.	In sandstone.
For 1837	7·5 days	7·1 days	4·9
1838	6·8	6·8	3·6
1839	7·8	7·2	4·6

"*Observations on the Tides in the Harbour of Glasgow, and the velocity of the Tidal Wave, in the estuary of the river Clyde, between Glasgow and Port Glasgow.*" By William Bald.

Mr. Bald stated that he had been for a considerable time past engaged in making observations on the rise and fall of the tides in the harbour of Glasgow. The first series of observations was commenced on the 26th of April 1839, and extended to the 1st of October 1839, and contain 158 observations of the rise and fall of the tides. The first portion of these observations were only made during the day, and did not extend to the night tides. These 158 observations assigned the mean rise and fall of tide in the harbour of Glasgow, to be 6 ft. 7 in. 20d.* The number of tide observations made from the 1st of October 1839 to the 27th August, amounts to more than 1,200. These also had been tabulated and divided into months, but such of the tides as have been much disturbed by floods Mr. Bald had rejected. By reference to the table exhibited for October 1839, the first line stated from the 1st of October to the 7th of October, number of tides 13; mean rise and fall of these 13 tides was stated to be 6 feet 5 inches; the mean low water of these 13 tides below top of South Quay wall in the harbour of Glasgow, was 15 ft. 8½ in., the mean high water below top of South Quay wall, 9 ft. 3½ in.; and the mean half-tide level below top of South Quay wall, 12 ft. 6 in. The table showed the number of tides for new moon, first quarter, full moon, and last quarter; the total number of tides for each month, the mean rise and fall of tide per month, the mean low water below top of South Quay wall, mean high water below top of South Quay wall, and mean half-tide level below top of South Quay wall per month. The mean rise and fall of these 1213 tides assigns an average of 6 ft. 8 in. 98d.; and the first series of 158 tides assign a mean rise and fall of 6 ft. 7 in. 20d. It also appeared from other tables and observations, that the tidal wave runs from Port Glasgow to Bowling, at a rate or velocity of 14·56 miles per hour. from Bowling Bay to Clyde Bank, at a rate of only 6·82 miles per hour; but from Clyde Bank to Glasgow Harbour at a rate of 10·85 miles per hour. The diminished velocity between Bowling Bay and Clyde Bank arises from the channel of the river being more crooked in that part than any other portion, thereby showing the great necessity of straightening and improving it.

* Smeaton, in his report on the River Clyde, dated the 3rd September 1755, states the neap tides as only being sensible at Glasgow Bridge.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Monday, Dec. 7.

The first meeting of the Session was held this evening, the President Earl De Grey, in the chair. His Lordship in taking a short view of the arrangements proposed for the opening session, congratulated the members upon the prospects before them, and upon the increasing prosperity of the Association.

A paper was read upon some of the characteristics of the "Gothique flamboyant," from the pen of Professor Willis, honorary member. The peculiarity to which the Professor chiefly referred, was the complicated manner in which the mouldings and members are made to cross and interpenetrate in the French Gothic. The system is not unknown in the English perpendicular style, but with us it is confined to such cases as arise simply from the juxtaposition of the component parts of the architecture, whereas in the Gothique flamboyant, new members are unsparingly laid one over another with the express object of producing the most intricate combinations. Some curious examples were exhibited from the Cathedral of Nevers, and other continental buildings.

Dec. 21.—Charles Barry, Esq., in the Chair.

M. Duban, of Paris, and Signor Raffaele Politi, of Girgenti, were elected honorary and corresponding members.—The former of these gentlemen is the architect of the New Ecole des Beaux Arts, at Paris, and is greatly distinguished by his knowledge of the French national architecture of the sixteenth century.—Signor Politi is the author of a work on the Antiquities of Agrigentum, and is well known and highly respected by all English artists who have visited the shores of Sicily in the prosecution of their studies.

A paper was read on Gothic Vaulting, by Mr. Ferrey, Fellow, exemplified by a description of St. Katharine's Chapel, at Abbotsbury, in Dorsetshire, a building of the reign of Edward IV., very peculiar both in its design and construction, and especially remarkable for its great solidity, which seems to have been dictated by the elevated situation of the building, and its exposure to violent sea storms. The roof, which is a wagon headed vault is of solid masonry, every part affording a like degree of strength, contrary to the ordinary mode of Gothic vaulting, where the ribs alone yield support, the panels being rebated or borne on the back of them. Upon this vaulting is laid a body of rubble, shaped to the angle of the external roof, and upon the rubble the outer covering, consisting of regular masonry, each stone having a level bed, and being therefore secured in a manner totally different from stone tiling. The details of this roof, and of several other Gothic vaults with which Mr. Ferrey compared or contrasted it, taking occasion to introduce many general remarks, were exhibited in numerous drawings, and an attempt to follow the subject, independently of these illustrations, would be an injustice to an excellent practical paper.

ARCHITECTURAL SOCIETY.

Ordinary Meeting: 17th Nov., 1840.—Michael Meredith, Esq., in the Chair.

The Chairman expressed his regret at being obliged to inform the meeting that Mr. Phillips, who was to have read a paper this evening, had very unexpectedly been called from London, and was, in consequence, unable to fulfil his engagement with the Society, and having apologized for Mr. Philip's absence, stated that he had, by special request, brought up, for the inspection of the meeting, drawings to the same scale, from actual measurement, of three churches built by Sir Christopher Wren, viz., St. Bennett Finck, Threadneedle Street; St. Bartholomew, Bartholomew Lane, Bank; and St. James's, Garlick Hill, Doctor's Commons. Also two sketches, being designs for the new painted window, Bishopsgate Church.

Mr. Meredith made some observations on the system of competition, which were well worthy of consideration, and in so doing introduced to the attention of the meeting the designs for the new painted window in Bishopsgate Church, and he finished this portion of his subject by some interesting remarks on the design and effect of painted windows in general.

Mr. Meredith also made some observations on the great talent exhibited by Sir Christopher Wren in the designs of the churches introduced this evening, and offered a summary comparison between the churches erected by Sir Christopher Wren in general, and those erected by other architects in and about London.

Monthly Meeting: 1st. Dec., 1840.—William Tite, Esq. President in the Chair.

Mr. A. W. Hakewill read a most interesting paper, being extracts from the life of Mons. Percier, which he enlarged upon with some very ably penned remarks of his own, founded on observations made while in pursuit of his studies in Rome and Italy, and having reference to the classic taste displayed in the buildings of that country, and also to the fitness of the design for the purposes intended.

MEETINGS OF SOCIETIES IN JANUARY.

At Eight o'clock in the Evening.

Institution of Civil Engineers, Tuesday	12	19
Royal Institute of British Architects, Monday	11	25
Architectural Society, Tuesday	12	26

TEMPLE CHURCH.

(From the Times.)

Within the present century a marked, and it may be called a classical taste has in general been shown whenever repairs or additions have been required to the ancient architectural remains, the legacies of our Anglo-Saxon ancestors, whether ecclesiastical or civil. The real or affected distaste for what was contemptuously called Gothic architecture, which may be dated from the time of the second Charles, continued to increase till the accession of George III. The passion for the antique in the reign of the former would appear even to have blinded Sir Christopher Wren to the absurdity of attempting to improve the wild and mysterious architecture of Saracen or Celtic origin, by uniting it to the classic regularity of the Greek or Roman school. The failure of the attempt appears in the towers of Westminster Abbey, and in the altar screens of many of the cathedrals erected from his designs. It is but in the present century that the genius of Wyattville restored the royal seat of Windsor to that character of castellated and palacial magnificence which the fopperies of Charles had obscured. How many sacred edifices might be pointed out, the "dim religious light" of whose venerable walls seem as if they breathed devotion, and which, in the most careless, are calculated to call the mind from the thoughts of the fleeting present to the eternal future, were they not desecrated by the "beautifications" which on all sides they are informed have taken place, during the presidency, may be, of the worshipful churchwardens Ebenezer Smith, or Timothy White, the testimonials of whose patriotic parochial monstrosities are handed down to posterity emblazoned in golden letters on gigantic tablets, and the fruits of whose exertions appear in the loads of whitewash and paint which has destroyed the severity and altered the character of the ancient structure. The time-worn banner of the founder in many may still be seen drooping over the poetical encomiums passed on the machinations of these utilitarian worthies, as if it "lamented the weakness of these later times,"

These heresies of taste are, however, giving way before a better understanding of the beautiful, as is exemplified in the repairs which have lately taken place in the cathedrals of Norwich, Rochester, and Peterborough, the Abbey of St. Alban's, and the borough church of St. Saviour's, from which last the western part of the edifice must, however, be excepted.

That affectation of puritanical simplicity in the fitting up of our churches, which to many of them has given rather the appearance of a hall devoted to the meetings of a civic council than a temple of divine worship, is also fast disappearing: a better taste has arisen, which is shown in devoting the labours of art and the efforts of genius in decorating the edifice itself, making it worthy the purpose for which it is designed, rather than in extolling the parentage of living monied humanity, or applying it to the luxurious accommodation of those who feel more disposed to hear the Gospel of truth when they find, in the house of their creator, the luxurious accommodations of their own.

The church called the Temple, although considerable sums were, some few years since, expended on it, has, on inspection, been found in such a state of decay, that its actual existence, for any lengthened period of time, was more than doubtful: in consequence of this, the Societies of the Inner and Middle Temple have generously determined that it shall be restored to its pristine state and beauty; they have justly considered themselves as guardians of one of the most ancient and beautiful ecclesiastical monuments of our country, and one of the very few which the fatal fire of 1666 spared in the metropolis. In the repairs of this church, it has been determined entirely to adhere to the ancient model, to do away with all the meretricious additions and miscalled embellishments with which its walls have been encumbered, to clear the interior of the wooden pens which have been planted in it, and to offer it to the antiquarian and the public, when completed, as the most perfect metropolitan specimen of the olden time.

The repairs of this church, when finished, will make it so perfect a specimen of ecclesiastical architectural beauty and chaste magnificence, as can hardly be rivalled in the kingdom. Many of the cathedrals may, in portions of their elevations, and in the ornamental garniture, if it may so be called, of their interiors, be as perfect: but as they have, with few exceptions, been erected in different ages, their architecture does not symmetrically harmonize together. There are few of them in which the Saxon, the Norman, the Saracen, the Gothic, or the Greek or Roman style is not blended in different portions of the edifice, and, the eye becoming confused by diversity, the effect which a symmetrical whole has on the imagination is lost. It may even be a matter of doubt whether the introduction of modern monumental sculptures, however great may be their merit as works of art, when not in alliance with the character of the locations in which they are placed, does not materially deduct from the effects of both.

The repairs and alterations which are taking place in this church consist in removing all the pews which occupied and encumbered the centre of the building; they will be replaced by a series of stalls carved in oak coeval with the character of the edifice, which will be placed north and south in the manner of those in a cathedral, sufficient space is left between them and the walls to allow a passage; in the centre will be convenient moveable benches. By this means the magnificent grouped columns will be visible from their bases to their capitals: the modern screen erected in the time of Charles II., which separated the western from the eastern portion of the edifice, is removed, as is also the organ, which was placed upon and completed the partition; it will be fixed on a building which has been erected on the western side of the structure, which communicates with the interior of the church by two of the lateral windows. By this arrangement a great advantage is gained, the whole extent of the church, with its lofty columns, intersecting arches, and vaulted roof, strikes the eye on entering the Roman portico of the western entrance. It was incontestibly proved, in removing the barbarous whitewash from the vaultings, that they had originally been painted in the most splendid tints; there was not enough left to show the particular design, but it has been determined that they should be restored, which has been done with the elegance and richness which characterized ornaments of the class. The vividness of the colours and the delicacy displayed on this mosaic fresco, relieved by the dark sculptured divisions of the vault, has rarely been surpassed. On removing the floor to examine the bases of the columns, it was found that its original level was considerably below its late one; it is to be so replaced that they will have their just proportions: the pavement will be formed, not partly of wood and marble as before, but painted tiles and tesselated pavement, in the manner of those of the sanctuary of Winchester. The three windows at the eastern end of the church and others at the south side, will be filled with stained or painted glass in the ancient manner, composed of small pieces, the figures and ornaments of which will harmonize with the age of the edifice; they are in the hands of Mr. Willement, who designed the ceiling; he has preserved in them that minuteness of execution, that delicacy of detail, and that brilliancy of colour united with chasteness of design, which so well assimilates with the architecture of a Gothic edifice. The arms of the Society will be emblazoned in it, those of the Inner Temple, which consist of a horse striking the earth with his hoof, or "a Pegasus luna on a field argent."

The monuments, excepting those of the recumbent knights in the round church, have been removed, and it is proposed to erect a cloister adjoining, and communicating with the edifice, to receive them. This will be a great improvement: the beautiful simplicity which the building in its leading lines presents, a heterogeneous series of monuments, tablets, and inscriptions must necessarily destroy; the space between the windows is too small, and never was intended for them; besides which, it will allow of these parts having a decoration of ornamental painting, similar to that of the ceiling, this being necessary to give due and complete effect to the latter. Immediately under the windows is a marble cornice, which, when restored, will seem to belt round the building and justly lead the eye, by its unbroken line, to give full value to its extent. All the smaller columns which are attached to the internal ones that support the roof, and those on the side walls which receive the ribs of the arches, are found, the smaller to be Purbeck marble, and the larger of Caen stone; whitewash, neglect, and age had effectually concealed their beauty; the splendid polish of the former, which rivals a mirror in brightness, will be restored, and their hue of ebony will stand in effective contrast with the cream-coloured hue of the latter. The caps of those in the round church are beautifully carved, according to the fashion of the age in which they were constructed. The outline of all is uniform, and the detail of each is varied; by this a simplicity and singleness of effect is produced in the whole, and the minutest examination presents a never-ending variety, by which the first impression is extended and maintained. The whole of these architectural restorations are being executed under the direction of Mr. Savage, of Essex Street. When completed, this ancient edifice will become an additional ornament to the metropolis—a perfect and unrivalled specimen of the olden time. But the restoration of this beautiful church is not the only good which the liberality of the Societies of the Temple will have effected; they have been the means of proving what may and can be done by the artists and artizans of England, when taste directs and liberality remunerates. Such an example, set in such an edifice, will, in all probability, have a powerful effect in the progress of church decoration in all its departments.

LAND SURVEYING—THE SCALING INSTRUMENT.

Sir—Though having had something to do with the improvement of the new scaling instrument, now used in the Tithe Commission Office, yet I do not feel called on *seriously* to contradict the assertions of "Surveyor," which appeared in your last month's publication. Nor would I presume to obtrude the following observations on your pages, if the remarks that called them forth had not a tendency to contravene the great principle upon which your very useful work is professedly based. It appeared that your valuable publication was to be made the great reservoir wherein to deposit the beneficent contributions that freely emanate from the generous and communicative head of genius, and from which source, those valuable contributions may be made liberally to circulate for the noble and philanthropic purpose of giving increased facility to the *practical efforts* of such persons as may not be so largely endowed with the inventive faculty.

Some few however there are to be found so exceedingly contumacious—so irresistably wedded to old prejudices—and so very vain of their fancied perfections in their several professions, that, like the barbarian Chinese, they reject with affected scorn every proposed improvement, the adoption of which would involve them in the painful and humiliating admission, that there existed such a *monster* as a *superior!*

With "Surveyor," continuous labour is professedly preferable to ease and dispatch. If labour be the consequence of a "curse," every inventive ability given and exercised, to remove or lessen that physical incubus, evinces a disposition somewhere to lighten the anathema: but if the stand still or retrograde movement stupidly advocated by "Surveyor," be acted on, we must be content (though human necessities daily increase) painfully to endure the miserable infliction: we must be satisfied to spend months at the drudgery of trigonometrical, or astronomical, or other calculations *in the old way*, rather than avail ourselves of the "ready reckoner" or the log books prepared by a Napier or a Newton—lest the month's labour should be diminished to *so many* days—and that we might not *dishonourably* substitute the easy effort of the boy, for the overstrained and painful exertions of the man!!

But we tell "Surveyor" that there is not the slightest chance that his intimation will have any effect. And likewise, that the advocates of all petty interests and monopolies, however they may frown and storm in their pigmy habiliments, must bow the neck to the overwhelming force of successful improvement and reform.

From the self-confident tone of "Surveyor," one would be led to suppose that he would willingly submit to a fair trial between his old method and the application of the instrument; if it were only for the purpose of convincing other persons who have given it a trial, that he was sincere in his rejection of it; and that he had no sinister motive for giving public expression to the act of "laying it on the shelf."

I now confidently assert that the same quantity of average work may be done twice with the instrument, for once that it can be done by "Surveyor's" method, and with a much greater degree of accuracy, and defy him to the practical disproof upon any fair conditions he may propose.

One can scarcely suppress the full ebulition of his risible faculties on reading the latter part of his letter, at his puerile attempt to touch the high reputation of a notable and eminent engineer, by his ("Surveyor's") *generous* offer of a lesson at the chain. From such a sample we may expect that the next unsolicited proposal of this astonishing preceptor will be, to instruct some of the first literary characters of the day in the letters of the alphabet. On this point, however, it is apparent that the very limited extent of his own acquirements has rendered him incapable of recognizing or appreciating the full extent and variety of, individual acquisition.

With these few remarks I beg to conclude, hoping that if "Surveyor" should again have any desire for entering your columns, that he will do so with a single eye to the main object of your Journal, and not under the mere influence of selfish or vindictive passions.

I have the honour to remain, Sir,

Your very obedient servant,

B. T. C. O.

December 24, 1840.

REVIEWS.

(*Continued from page* 16.)

A Practical Inquiry into the Laws of Excavation and Embankment upon Railways, &c. By a Resident Assistant Engineer. London: Saunders and Otley, 1840.

(Second Notice.)

The remaining part of this work which we have announced our intention of noticing, is devoted to the investigation of the barrowing system, in which the author proposes to give the result of his inquiry into the subordinate system of removing earth by means of wheel barrows and human labour. We regret that even the small share of praise we felt justified in bestowing on the first part of the treatise cannot be extended to the part now before us.

And in order that our readers may the better judge in what degree the author is warranted in the strong contrast which he draws between his own labours in this field of inquiry, and those of former writers, we shall present them with an extract from his works, rather out of its true position, namely, the concluding paragraph, in which he glances with some contempt at the efforts of his predecessors, and turns with infinite complacency to the superiority, in all respects, of the process which he has himself employed.

> It will also be seen, that the principles upon which former authors attempted to develope the general laws of excavation and embankment, were evidently adopted, without any reference to the practical working of the system: and, that the mode of making their observations, (whenever they were made), was much too isolated, for the purpose of affording an expanded and comprehensive view of the various agencies—collateral and direct—which are continually acting, one upon the other, and by which the ultimate results are collectively influenced. The error into which they have fallen, seems to have consisted in assuming, as their constants, quantities in the abstract; or in observing in detail, instead of the aggregate; and adopting the results of these separate observations, as if entirely independent one of the other: and therefore it is not to be wondered at, that many matters, essential to the thorough sifting of the subject, were altogether excluded: and that the arguments founded upon these self-begotten phenomena, led them to a belief. in the inverse ratio to probability, if not of possibility itself. Thus, the antecedents being widely unconnected, and, from their number, subject to frequent error; the consequents derived from their combination, turned out utterly fallacious. The method we have pursued is exactly the reverse: our constants depend upon observations, made upon the combined effects, produced by the various agencies in the aggregate: and, by an analysis of these we have descended, step by step, to the details; and not advanced, from the minutiæ of detail to abstract generalities, which have no foundation in truth

We shall reserve till the end of our review the observations we have to make upon the boasting presumption of the latter sentence, remarking merely, in the mean time, that a more complete delusion never entered into the mind of man than that which seems to have taken possession of our author, when he imagines that he has made any thing like an analysis of the subject of which he is treating. His process has been on the contrary purely synthetical, and we fear that rarely have such weighty and important conclusions been based upon such a miserably scanty foundation.

The experimental part of this investigation commences with three experiments, from which our author derives the following fact: "*that the mean time spent in filling a barrow, wheeling it four runs of twenty-five yards each, and returning with the empty barrow, is* 5′ 45″. He then gives two experiments which determine 7′ 20″ *for the time spent in filling one barrow, wheeling it four runs of twenty-five yards each, and returning with the empty barrow,* including *also the time spent in filling the same barrow a second time, and wheeling it forward two runs.* Hence taking the difference of these two times, the author makes 7′ 20″—5′ 45″=1′ 35″, the times which elapsed in filling one barrow and wheeling it forward two runs, or which is the same thing, 1′ 35″= the time of filling a barrow, wheeling it one run, and returning with the empty barrow.

It is next assumed that the time of filling the barrow must be equal to the time of wheeling over one stage, and returning with the empty barrow. Hence $\frac{1' 35''}{2} = 67''$ (17″) the time of filling each barrow. The whole time occupied in making the experiments from which this result has been derived is somewhat less than 32 minutes, this being the sum of the observed times in the whole five experiments.

We need scarcely pause to notice how completely inadequate must be a limited experience of this kind as a standard for estimating either the expense or rate of progress in removing earth by barrows. As well might a traveller estimate his rate of progress from the beginning to the end of the journey, by observing his speed during some particular half hour. As well might a vessel's rate of sailing for weeks, months, or for a whole year be infallibly prognosticated from the information afforded by a simple page of the log book.

We challenge all the examples since the beginning of time, where grand conclusions have been drawn from insufficient premises, to bear comparison with the instance which our author has here furnished. Telford, Rennie, Mylne, Smeaton, and all the other great engineers under whose guiding genius not a few great earth works have been executed long ere railways were thought or heard of, how many a laborious inquiry, and how many a painful lesson would have been saved to you, had the experience been yours, of the half hour during which these important experiments were made.

It is due to our readers, however, to inform them that there are three more experiments, "conducted," say the author, "in a different manner." The difference consists in this, that these experiments are made upon a number of barrows together, instead of single barrows, as in the first set of experiments.

We relate this second series of experiments in the author's own words, and we make no comment upon them, as our readers will perceive at once that they are equally insignificant in point of extent with the first five which we have noticed at length.

Experiment 1.—Twenty-four barrows were filled, wheeled forward two runs, and tipped, in thirty-eight minutes and forty-eight seconds: which is the same in effect, as if they were filled, wheeled *forwards and backwards*, and tipped upon *one* run, during the same time.

Experiment 2.—Eighteen barrows were filled, wheeled forward one run, and brought back empty again, in twenty-five minutes, and forty-two seconds.

Experiment 3.—Eleven barrows were filled, wheeled forward upon two runs, and emptied, in eighteen minutes: which is the same in effect, as if they were filled, wheeled forward, emptied, and brought back, upon one run.

From these experiments it is determined that 1′·37″ is "the mean time which elapsed while a single barrow can be filled, wheeled one run, emptied, and brought back;" we are then told that 37 barrow loads can be wheeled on each road per hour. And our author, assuming, we suppose, the weight of all earths to be the same, derives from this fact the performance of each single barrow road, and upon any number of these working together. It is obvious that this assumption is most erroneous, as for example, the specific gravities of different soils may be stated thus, common mould 1·46, sand 1·52, sandy loam 1.6, clay or marl 1·712, gravelly sand 1·784, gravelly clay 1·93, common land gravel 2·017, rough water gravel 2·32, common sand stone 2·5, lime stone 2·7.

Thus, supposing that a man can wheel of common mould 37 cube yards in a day of 10 hours, which accords with the author's statement of his performance, he would only be able, with the same labour, to wheel 23 cube yards of rough water gravel. And, without multiplying examples to show the fallacy of any assumed standard, such as the author derives from his experiments, it may be observed, in general terms, that the quantity which can be wheeled will be inversely proportionate to the specific gravity of the stuff, and not by any means constant for all soils.

Another error into which the author has fallen, is that of taking 25 yards as the invariable length of a run. Our own opinion is, that this is too great a length for a level road; but, besides this, it is most important to notice that, in order fairly to apportion the labour of wheeling, the length of each man's run must vary according to its rate of inclination. In practice this is always attended to, the workmen usually being quite expert at fixing the position of the stages or resting-places, according to the slope of the run.

There is yet a third error which we cannot pass over, namely that of supposing two men always to be employed in filling, during the time of the wheeler's absence, so that one loaded barrow may always be ready for him each time he returns to the filling place. It is evident, and experience, moreover, has shown, that in some soils, such as light sands, a single filler will keep the wheeler constantly going, whereas in others, such as stiff clays and marls, three and even four men are necessary for the same purpose.

Of such consequence, in an inquiry of this kind, are the particulars which, as we have seen, the author has omitted to consider, and so fallacious are the general assumptions in which he has indulged, that we cannot refrain from expressing our decided disapprobation of this second part of the work.

We have only further to remark, that with all these faults in his own work, it is scarcely to be borne that such a lofty contempt should be evinced by the author for all that has ever been written before on this subject. Certain we are, and we are happy to say it for the honour of the profession, that there are not wanting many, many practical men, who, if they have never *written* on the subject, contain in their own heads, or perhaps in the shape of private memoranda, such a complete acquaintance with the system of barrow work, that they can predict accurately, on examination of the locality, every circumstance of expense, time of execution, number of men and quantity of materials required, in any particular work.

This, we presume, would indicate at least as much knowledge of the subject, in all its bearings, as the author of this inquiry could possibly imagine any person capable of acquiring from the pernsal of his work. But how different in value must that knowledge be which is obtained by the practical experience of years, from that which is based upon the experiments of a few hours' duration. The information of the practical man consists of gross results, with all the attendant circumstances of which he is, or ought to be, acquainted; and his method of arriving, where necessary, at the separate details, is really analytical, and so directly opposed to the process of establishing gross results from separate experiments in detail.

LITERARY NOTICES.

A very able work "on the Law and Practice of Letters Patent for Inventions," by Thomas Webster, Esq., has just been published, we shall notice this work in the next month's Journal.

Mr. Whishaw's long expected work on the Railways of Great Britain and Ireland has at length appeared. We received it so late in the month that it precludes our examining it with the attention which it deserves, we must therefore postpone our remarks, excepting so far as saying, that it contains several engravings of Locomotive Engines, all the rails in use, and other details connected with railways, very beautifully executed; with valuable tables showing the results of practical experiments as to the actual working of English Railways.

The History of the London and Birmingham Railway, by Lieut. Lecount, is a republication of his interesting and valuable contributions to Roscoe's illustrated work on that subject.

The Building-ground Calculator, by E. W. Garbett, Architect, contains a series of Tables for ascertaining the value of Land per acre, when divided out into plots of various depths from 100 to 300 feet, at prices from 5½*d.* to 14*s.* 5½*d.* per foot frontage, or £10 to £105 per statute acre.

NEW INVENTIONS AND IMPROVEMENTS.

Improvements in the construction of steam boilers and engines, and of locomotive carriages: patented by Frank Hills, of Deptford, manufacturing chemist, November 5, 1840.—These improvements are numerous and difficult to explain without the illustrative engravings; a tolerable idea of their nature, however, will be conveyed by the following list of the ten claims;—1. The employment of a series of vertical tubes partly filled with water, and having small pipes passing down their centres, forming passages for smoke or heated air. 2. The employment of a series of vertical tubes which are closed and unconnected at the top, and open at the lower end, which communicates with a chamber, or series of chambers, partly filled with water; and which tubes have small pipes passing up their centres, for the purpose of conveying the steam to the boiler with which they are connected. 3. The use of flat chambers connected by means of pipes, filled with water, the upper portion of such chambers, forming steam chambers. 4. The employment of wooden felloes to wheels used for locomotive and other carriages, which felloes are enclosed between two vertical wrought iron rings, to which the spokes of the wheel are welded. 5. The employment of hollow arms, which are open at the ends on which the wheels revolve, and through which opening the driving shaft passes. 6. The employment of collars or enlarged pieces running in bearings, which have a groove and are connected with the brass containing oil, in order that a regular supply may be afforded to the working parts requiring the same. 7. The method of filling up the space between the arms of the (Hero's) engine. 8. The method of reversing the motion of the engine by employing two sets of arms, with other apparatus hereafter described. 9. The mode of inserting a wooden block or other slow conductor of heat between the tube which communicates the motion and the driving shaft. 10. The mode of imparting motion to an engine shaft, by means of an arm or crank being fixed on the middle of such shaft, and driven by one of two connecting rods alternately, which are both driven by the piston rod and guided by radius rods.—*Mechanics Magazine.*'

Improvements in wheels and locomotive engines to be used on railways: patented by David Gooch, of Paddington, Engineer, Nov. 20, 1840.

These improvements consist simply in forming the outer or working surface of the tire of engine and carriage wheels, of steel, which may be made of any required degree of hardness. The application of steeled tires to wheels used on railways, (it is said) has hitherto been prevented by the difficulty of forging and fixing them. The following method of surmounting this difficulty is Mr. Gooch's:—A faggot of wrought iron bars are worked and hammered, or rol ed into a solid piece, and afterwards drawn out in rolling, or under the hammer upon an anvil, having a groove to form the flanch, into the state of rim iron. An indentation or hollow is then made, lengthwise of the bar near the flanch, in order to prepare it for the reception of the steel. A faggot of steel bars is then so arranged, that when hammered and worked into its proper (wedge) form, the edges of the bars shall form the broad surface of the tire. The two bars of iron and steel thus prepared are then welded together, and afterwards formed into a rim or hoop of the form required. The wheel being prepared in the usual way, and its rim turned, it is laid flat on a true face-plate, and the tire being regularly and uniformly heated red hot, is put round it. The whole is then plunged into cold water or other frigorific mixture, which contracts the tire and hardens the steel. Holes having been previously drilled through the steel hoop, are now continued through the rim of the wheel, and both are rivetted together. Or, the rivets may be advantageously dispensed with when the steel is driven well into the indentation prepared for its reception. "Many important advantages," says this patentee, "will arise from the use of steeled tires on railways; besides the economy immediately resulting from the greater durability, a vast reduction will be effected in the wear and tear of the engines, the carriages and the rails; while a corresponding improvement will arise in the comfort and safety of travellers. The intense friction to which the wheel is subjected, occasions a rapid wear and tear of the iron tire, productive of most injurious consequences. An indentation is soon formed by the rails on the tire, which disturbs the action of the wheel, and destroys smoothness of motion. The same causes derange the action of the engine itself; every revolution of the locomotive wheel brings an irregular strain on all the parts, which materially increases the wear and tear to which they are liable. Great damage is also done to the railway, on which the wheels at every revolution act like so many ponderous hammers. It has been found advantageous to make the working surface of the wheels conical, diminishing from the flanch; but the conical surface of the iron tire is soon worn down, and the wheel made conical the reverse way, causing a serious loss of tractive power and increase of friction on all the parts affected. By the use of steeled tires these evils are henceforth to be avoided, the extreme hardness of the surface enabling them to endure without injury the action of the rails for a considerable length of time."—The claim is, 1. The mode described of forming and hardening steeled tires of wheels to be used on railways. 2. The use of steel in the tires of engine and carriage wheels for railways.—*Mechanics' Magazine.*

An improvement or improvements in the mode of resisting shocks to railway carriages and trains, and also in the mode of connecting and disconnecting railway carriages: also in the application of springs to carriages; patented by William Henry Smith, late of the York-road, Lambeth, but now of 20, Rockingham-row, West, New Kent-road, Engineer, dated Nov. 28, 1840.—The first improvement consists in applying to railway carriages certain combinations of machinery or apparatus, affording an increased length of elastic resisting power, with a consolidated action of the same, calculated to obviate the present liability to danger. The second, a peculiar mode of connecting the engines or carriages, whereby they may be more readily attached to each other, or instantly detached, thus placing them more completely under the control of the engine-man or conductor, by whom the connect on may be broken (without his leaving the foot-plate) in case of the engine getting off the rails or meeting with any other accident; or a solid connection may thus be formed between the carriages, causing a simultaneous action of the whole train upon one point of resistance, thereby lessening the amount of spring or other elastic resistance required, and at the same time ensuring greater safety and efficiency of action. The third, consists in a certain application of the vertical or side springs, by which is obtained in a greater degree an universal action of the carriage, presenting an increased elastic resistance in the direction of the shock, whether lateral or vertical. In the first case, a series of helical or other springs are placed in parallel rows, side by side, beneath one of the carriages; a single buffer-bar extends, by connection, through the whole length of the train, and projects about five feet beyond the carriages at each extremity. This buffer-bar is connected to two cross arms, which abut against the two ends of the series of springs already mentioned. A buffer at the end of the bar receiving any shock, it is transmitted along the bar to the cross pieces impinging on the springs, which present an elastic resistance to such pressure. As these springs can be acted upon from either end, should a collision occur from one train overtaking another, both would, if thus equipped, be found unhurt, the consolidated resistance in each being brought simultaneously into action. Another mode of resisting sudden shocks is by means of a male screw upon the buffer-bar running along the under side of the carriage frame, having a quick thread "so as to fall by its own gravity," and turn freely in a nut or collar firmly affixed to the carriage. Any shock, it is said, would be transmitted through this collar in a much less degree (proportioned to the angle of its thread). The end of the screw is attached to a strong verge spring, which increases the resistance to the turning of the screw as it is wound up, so as completely to overcome the shock. The screw is acted upon by a buffing-bar. "The main value of this part of my invention," observes the patentee, "is, that the spring is affected but in a small degree by the amount of shock endured; its principal portion being received in the collar, and the resistance not increasing in the same proportion against the spring as in the ordinary methods: but by the screw's application, I calculate, five-sixths of the effect of the concussion would be received by the collar (*ergo: by the* CARRIAGE), and the same proportions to any extent." A third method of resisting shocks is by means of an hydraulic apparatus, consisting of a large close cylinder filled with water, placed under the carriage; a piston works loosely in this cylinder, the piston rod passing through a stuffing box, and forming the buffing bar; a passage under the cylinder, which connects its two ends, is closed by a cock. On encountering a shock, the buffer-bar forces the piston along in the cylinder, the water rushing from before it through the open cock, the contracted orifice of which impedes its progress and checks the motion of the piston. As the piston rod is pushed in, a connecting rod passing from it to the cock closes the latter, when the water can only escape by the sides of the piston, thus offering a still greater amount of resistance. The piston is capable of working either way, according to the end of the train from which the shock is received; and owing to the piston not fitting tightly, there will be no liability of it or the cylinder receiving any injury. There is a reacting spring for restoring the piston to its original position.—The mode of connecting and disconnecting railway carriages is by the following arrangement:—A connecting bar is attached to the engine by a pin joint, and kept in the right position by a staple pendant from the foot-plate; at the other end of this bar there is a piece projecting upwards. A bell-mouthed aperture is let into the front frame of the tender or carriage, which guides the before-mentioned bar into the recess in case of any variation of the relative positions of the carriages. On pushing the carriage, &c. up to the engine, the bar enters the aperture, pressing down a strong spring until the projecting piece of the bar enters a slot or cavity prepared to receive it, when the spring rises and forms a permanent connection. In order to disconnect the engine, it is only necessary to press with the foot upon a small rod, which, acting on the projection, forces down the spring and allows the bar to be withdrawn.—The new mode of applying springs to carriages of every description, consists in adapting four sets of helical springs, to work obliquely between the wheel axles and carriage frame, being inclined at the angle of about 40° from each other towards the ends of the carriage. The object of this arrangement is (said to be) to receive the jerk in whatever way it may come, either from the wheels or the buffers, and transfer it to the opposite spring, which together (the one by compression, the other by expansion) present an additional resistance to the action of the shock. These springs have also a double vertical action resisting shocks either from above or below.—*Ibid.*

Improvements in railway and other propulsion; patented by John George Shuttleworth, of Fernly-place, Glossop-road, Sheffield, gentleman, Nov. 28, 1840.—The contrivance of this gentleman bears a very close resemblance, in many parts, to the atmospheric railways long before the public, except that in the present instance the patentee proposes to employ a denser fluid (water) as the motive power. A horizontal main or tube is laid along the line between the rails, having a slot or opening on its upper surface: this aperture is smallest at the top, and expands downward. A piston fits the interior of this tube, and terminates in a peculiarly formed guide-neck, for taking up and applying to the aperture in the pipes a continuous flexible valve or stuffing of india rubber or other suitable material. In front of the guide-neck there is one vertical and one horizontal wheel, to guide the piston steadily along the line with the smallest possible quantity of friction; while a thin metal plate passes up through the opening, and is attached to a railway carriage of the ordinary construction. At the commencement of the line, a vertical pipe conveys a column of water on to the horizontal main, through a valve or cock opened or shut at pleasure. The efficiency of this agent may be produced by the pressure of an elevated reservoir, or by the application of steam power to force it into the pipes. On turning the cock the water rushes into the main, and drives the piston, with the carriage to which it is attached, forward; the flexible valve, which lies along the bottom of the main, but passes through the guide-neck and up over the piston, is raised as the piston travels along, and forced into the opening of the pipes, where it is kept by the pressure of water behind the piston.—The claim is—1st. The application of the power of a column or body of water acting against a piston in a tube, to which piston a railway carriage, or other object to be propelled, is fastened for the purpose of propulsion. 2nd. The improved guide-neck to the said piston for raising and conveying to its proper place the flexible valve or stuffing required to fill the slot or space left open in the upper part of the propelling tube for the passing of the plate.—*Ibid.*

Improvements in the manufacture of certain descriptions of cement: patented by Richard Freen Martin, of Derby, gentleman, Dec. 2, 1840.

The improvements which form the subject of this patent, relate more particularly to those descriptions of cement for which a former patent was obtained, dated Oct. 8, 1834, but are also applicable to other cements, as set forth hereafter. In the former patent, in order to produce certain hard cements, it was directed that gypsum, either in its natural state or as plaster of Paris, or limestone, or chalk, or lime, in the state of powder, should be mixed with a solution of any strong alkali neutralized by an acid, (American pearlash and sulphuric acid being preferred) and that water should be added to the mixture till it was in a fit state for casting or moulding into cakes, and to be subsequently dried and burned. The patentee has since discovered that the said processes may be facilitated and the cost of them reduced in the following manner:—

First, instead of employing alkaline and acid solutions, the acids and alkalies are to be used in the solid state, either added separately or previously combined together, and no more water employed than the materials themselves contain.

Secondly, in certain cases the addition of the alkali, or both the acid and the alkali are dispensed with, and the quantities of these ingredients incorporated in the substances themselves are depended upon, to form the bases of the cements. In carrying out the first improvement, a quantity of pearlash is dissolved in water, to which is added a sufficient quantity of sulphuric acid to form a neutral compound; this mixture being evaporated to dryness, leaves the required compound in a solid state.

When it is desired to add the acid and alkali separately in a solid state to the gypsum, chalk, &c., pearl-ash is used and dissolved, or where cements of superior density are required, some of the alkaline earths (barytes for instance) are employed. The acid constituent is obtained by using sulphur or sulphuric acid in combination with other matters, as pyrites and mineral sulphates, or some solid substance containing both an acid and an alkali, as alum, &c. In this case it is necessary so to regulate the acid and alkaline proportions, that they shall always exactly neutralize each other. The acid and alkaline matter being provided in any of these ways, is to be mixed with gypsum, or lime-stone, or chalk, in the following proportion:—to any given quantity of either of the foregoing or similar substances, add as much solid alkali and acid as that for every part by weight of alkali (of the strength of the best American pearlash) there shall be about 150 parts of the gypsum, &c., or of the gypsum and lime combined in equal proportions. These materials are then to be ground together into a fine and well-mixed powder, which is to be first dried and afterwards calcined in suitable revolving cylinders. By the second improvement, cement may be formed by combining gypsum and lime with a third substance containing or producing an acid; or by combining gypsum and lime alone, without the addition of any third substance either of an acid or alkaline quality. 1. About two parts by weight of gypsum are to be mixed with one part of lime, and for every 100 parts of lime or thereabouts, there is to be added one part of sulphur, or of some substance from which acid is produced, regulating its quantity according to its superior or inferior acid-producing qualities. 2. To make a cement from gypsum and lime alone, these are to be mixed in such proportions as that the moisture given off in the process of calcining them together by the gypsum, shall be just sufficient to slake the lime. When the London grey-stone lime is used, about two parts of gypsum are required to one part of lime. In all cases the materials are to be ground and calcined as before stated. The mode of using the cements thus formed is the same as set forth in the specification of the former patent. It is found to be advantageous to use none of such cements in a fresh state.—*Ibid.*

Important to Mariners.—We have lately read so much of the calamity of shipwreck, that any attempt to lessen its horrors, must be hailed as a real blessing. Few that have not heard of Captain Manby's Life-Preserver. We have just witnessed a successful attempt of simplifying the principle upon which that valuable discovery is founded, so as to be available wherever a common cannon and a piece of rope are at hand. There is no occasion for a mortar or a rocket, a common ship gun will answer the purpose. The experiment was lately tried on the sea shore, about a mile southward of Aberistwith. We had been previously informed that Mr. Page, the superintendant of the Harbour Works, had, at the instance of the Harbour Trustees, directed his attention to the subject, and we are glad to state with the most perfect success. The machinery is the simplest possible. A common twelve pounder that belonged to the old *Agenoria*, was placed on the store, elevated to 40 degrees, and loaded with a nine ounce charge of powder, with a well fitted wadding. Before us lay a long coil of rope, ¾ inch diameter, with a stout piece of wood or plug, of the length of a common spade fastened to it. This plug is intended to be put in the mouth of the gun. The ploblem to be solved, was to project this piece of wood over the breakers before us, so that should a vessel have struck there, as we remember one to have done about 18 months since at that very spot, and the sea should be too high for any boat to live in the surge, a rope might be sent from the land to the ship, or from the ship to the land. The simplicity of the whole affair struck us extremely, and no alchymist waited with more anxiety the moment of "projection" than we did the firing of the cannon. Those that know anything of these matters will understand us when we say that our great apprehension was, lest the rope should *snap*—that being the great difficulty to be got over in these experiments. But our apprehensions were quite needless. The gun was fired once, twice, thrice, and the plug and rope were hurled beyond the breakers without a thread of the latter breaking or straining. Its length was 160 yards; but it might be extended by increasing the charge of powder. That peculiarity of the apparatus upon which the engineer mainly depends for counteracting the tendency of the rope to break is, by strengthening about two feet of that part of it which comes in contact with the plug: this is done by adding to it four others of the size of lead lines, and which are bound together with pieces of spun yarn, and fastened to the plug with four small staples, the main rope or a bit of chain instead, being fastened to it, by a ring and thimble. Thus strengthened, the rope is found sufficiently strong to stand unharmed against the jerk with which it is projected from the cannon, and this it could not do without the four extra supporters. Upon enquiring of the engineer why he preferred a wood plug to a rocket or ball, he stated that in case of a man overboard, the plug would *float*, and that also in case of being fired *from* a vessel, it would from its buoyancy be carried on shore by the mere action of the sea. Its extreme simplicity is its great recommendation. There are few vessels without a cannon of some size on board, and a hand-spike or capstan bar will answer the purpose of a plug perfectly well. We should have stated that the wetness of the rope after the first discharge was found to be of no inconvenience, but care should be had in coiling it properly, so as to enable it to play out with facility.—*Carmarthen Journal.*

New Code of Signals on the Great Western Railway.—The whole of the engine-drivers, stokers, guards, conductors, and other persons employed on the railway throughout the line were assembled at the engine-house of the Paddington station last week, when a new code of signals, prepared by Mr. Brunel, the engineer-in-chief to the company, were fully explained to them by that gentleman, and several of the signals were put into practical operation. A special train was sent from the Paddington to the Farringdon-road station, to convey the engineers, stokers, guards, &c., at that end of the line to town. By the adoption of the new code, distinct and immediate intimation will be given to the engine-drivers and others of the least obstruction along the line.

Eastern Counties Night Signals.—The manager of this company, R. Hall, Esq., has invented an ingenious system of night signals for the Eastern Counties Railway. On the back part of the chimney of the engine is placed a reflector, so inclined that a light pressing from the top of the train will be reflected down upon him. The two guards sent with every train are provided, besides their common lamps, with two signals consisting of blue and red lights. Upon the removal of a piece of tin, a screw presses upon some fulminating powder, which immediately ignites the signal, and gives out a most intense light for some time, which, falling on the engine reflector, is sent down concentrated upon the engine man, so that he is immediately aware of the signal. The blue light indicates caution, and the red light danger. The light is so exceedingly intense as to give a brilliant illumination all around, and the men who have tried it declare if they were asleep it would wake them. The present signals throw off several luminous balls in succession, but Mr. Hall will in future use the light only. At the junction of the Northern and Eastern, and other parts of the line, the men are provided with these signals. A sliding reflector is added to give greater power to the light, but from what we have seen, we are of opinion that that is unnecessary, as the lights are so strong that they may, in our opinion, be seen for 10 or 15 miles off.—*Railway Magazine.*

LAW PROCEEDINGS.

PATENT LAW—AMENDMENT OF SPECIFICATION.

IN THE MATTER OF JOHN SHARP'S LETTERS PATENT.

In the Rolls' Court, Tuesday, Dec. 22.

Lord Langdale pronounced his decision upon the petition of Joshua Wordsworth (reported in last month's Journal, page 428,) for expunging from the memorandum of alterations in the specification of Sharp's letters patent "for machinery for converting rope into tow," certain portions which were alleged to be in substance descriptive of the same machinery as was invented by the petitioner. The petition stated that Sharp had, under the 5th and 6th Will. IV., c. 73, with the leave of the Solicitor-General, entered with the Clerk of the Patents certain memorandums of alteration of part of his specification, which alterations the petitioner, Wordsworth, complained of as a new arrangement of machinery, extending Sharp's patent to what the petitioner alleged was in substance his own invention for heckling and dressing flax, &c., as described in his specification. His Lordship said he had delayed his decision for the purpose of collecting information as to what had been done by the Court respecting amendments of specifications, and it appeared it was usual to make amendments in the enrolment in cases where there were clerical errors *negligenter per incuriam vel ex lapsu calami scriptoris*, and this had been done, sometimes by reference to the Master of the Rolls, by the Lord Chancellor, and in one instance by the Lord Chancellor himself upon an order from the Crown, sometimes by writ of Privy Seal, sometimes by consent of the Attorney-General, and sometimes by sign manual. In all modern instances the alterations had been merely clerical. It did not appear that the Master of the Rolls as keeper of the records had ever exercised any authority in matters of this kind when the error complained of was not merely clerical. He was clearly of opinion that he had no authority to make the alteration asked for, and he must dismiss the petition with costs.

The Queen v. the Grand Junction Railway Company.—MANDAMUS.—*Court of Queen's Bench, November* 15.—Sir F. Pollock applied for a rule, calling on the Grand Junction Railway Company to show cause why a writ of mandamus should not issue, commanding them to obey the enactments of the 19th section of the Act 3 Victoria, cap. 19, which was as follows:—"And be it further enacted, that the charges of the said recited Acts, or either of them authorised to be made for the carriage of any passengers, goods, animals, or other matters or things to be conveyed by the said company, or for the use of any steam power or carriage to be supplied by the said company, shall be at all times charged equally and after the same rate per mile or per ton per mile, in respect of all passengers and of all goods, animals, on carriages of a like description conveyed or propelled by a like carriage or engine passing on the same portion of the line only, and under the same circumstances, and no reduction or advance in any charge for conveyance by the said company, or for the use of any locomotive power to be supplied by them, shall be made, either directly or indirectly, in favour of or against any particular company or person travelling upon or using the same portion of the said railway, under the same circumstances as aforesaid." He made this application at the instance of Messrs. Pickford, the carriers, who would, unless the court interfered to protect them from the company, be obliged either to give up the carriage business altogether, or to carry it on without deriving any profit from it. It appeared from the affidavits, that the usual method of transmitting goods from London to Liverpool and Manchester, was by the London and Birmingham Railway to Birmingham, thence by the Grand Junction Railway to Newton, and from Newton by the Liverpool and Manchester Railway to those towns respectively. The Grand Junction Company had, it appeared, granted to Messrs. Chaplin and Horne the accommodation of permitting the trucks on which their goods were placed to pass at once from the London and Birmingham line to the Grand Junction line at Birmingham, and from the Grand Junction line at Newton to the Liverpool and Manchester line, without any change of carriage or unloading, but since September last had refused to afford similar facilities to any other carriers; and when applied to by Messrs. Pickford on the subject, had informed them that they could not afford them the desired accommodation unless they paid something additional for it, while it was afforded to Chaplin and Horne gratuitously. The expense of loading and unloading the trucks would be about £5. a day additional to Messrs. Pickford, besides the loss of time which it would occasion them. It appeared also that the company at the Camden Town station charged 65s. a ton for the carriage of goods to Liverpool or Manchester, but they made Messrs. Chaplin and Horne an allowance of 10s. a ton for collecting and distributing the goods in London, which allowance they refused to make to Messrs. Pickford. There was a clause in every railway act empowering other persons than the company to start locomotives and trains on the railroad, but this was a complete dead letter, inasmuch as the company might refuse such persons the use of their pumps or of their coal depots, and had also unlimited power in regulating the times of starting, &c., of such engines. The fact was, the company was aiming at a complete monopoly of the carrying trade, which they would certainly acquire unless they were compelled to obey the enactments of the clause in question.—Mr. Justice Patteson granted a rule to show cause.

PROGRESS OF RAILWAYS.

Manchester and Leeds Railway.—Completion of the Summit Tunnel.—On the 9th ult. the last brick of this great undertaking was keyed-in by Barnard Dickinson, Esq., the resident engineer, who was presented on the occasion (by J. Stephenson, Esq., the contractor) with a silver trowel, the gift of the inspectors and sub-contractors on the works. The tunnel was lighted by torches, and a large company of ladies and gentlemen were present to witness the ceremony. At twelve o'clock, Mr. Stephenson, accompanied by his manager, Mr. G. Mould, Mr. Dickinson, and other gentlemen connected with the company, entered the tunnel amidst the acclamations of the party assembled, when Mr. Stephenson, in presenting the trowel, congratulated Mr. Dickinson on the successful completion of a work, which, but for the united skill and enterprise displayed in its execution, would have been insurmountable. Mr. Dickinson then finished this great work, by keying-in the last brick, amidst the cheers of the spectators; after which he delivered an animated address, in the course of which he observed that some idea might be formed of the amount of labour employed in the construction of the tunnel, when he informed them, that had it been left to the unassisted efforts of one man, it would have taken him as much time to complete it as had elapsed between the commencement of the Christian era and the present day, namely, one thousand eight hundred and forty years! At the conclusion of the ceremony the company were invited to partake of a cold collation at the Summit Inn, when several excellent speeches, having reference to the completion of the work, were delivered in the course of the evening. The workmen were also regaled with abundance of good cheer within the tunnel.—*Midland Counties Herald.*

Oldham Branch Railway.—On Saturday, the 12th ult., a number of the directors of the Manchester and Leeds Railway, accompanied by their principal engineers, visited Oldham, and examined the country between Oldham and the main line, for the pupose of determining the best course for the Oldham Branch Railway.

Contemplated Railway through Blackburn.—We rejoice in being enabled to state that the first step has at length been taken to secure to Blackburn and the surrounding district the advantages of a railway communication with the North Union and Manchester and Leeds lines. On Thursday last, a highly respectable meeting was convened by circular, at the Hotel, in King-street, to confer with Mr. Stephenson, the eminent engineer, and two other gentlemen of the same profession who accompanied him, upon the subject. The meeting was well attended, and but one feeling appeared to pervade the company, viz., an anxious desire for the accomplishment of the object in view. The engineers exhibited a map of the different railways, with the proposed line from the North Union at Preston, through Blackburn, Accrington, and Burnley, to the Manchester and Leeds line at Todmorden, a distance of about twenty-six miles.—William Turner, Esq., M.P., having been called to the chair, a long conversation took place between Mr. Stephenson, the chairman, William Feilden, Esq., M.P., Joseph Feilden, Esq., P. E. Towneley, Esq., James Neville, Esq., and others, the result of which was the appointment of a committee, to confer with the directors of the North Union and Manchester and Leeds Companies, and also with the owners of property on the proposed line; and to ascertain what pecuniary assistance they were disposed to render towards obtaining a survey, from Preston to Burnley, the cost of which was estimated at £700. The ground from Todmorden to Burnley, we believe, has already been surveyed; and it is understood that the Manchester and Leeds Company are disposed to extend their line to Burnley, provided another company be formed to continue it through Blackburn to Preston. Should this expectation be realised, and there appears no reason to doubt that it will, it will do much to facilitate the proposed undertaking.—*Blackburn Standard.*

PUBLIC BUILDINGS, AND IMPROVEMENTS.

Fresco in the New Houses of Parliament.—Cornelius, the celebrated German painter, is, it is said, on his way to this country, where he is to be consulted as to the frescos of the new Houses of Parliament. Certainly Cornelius has no merits which can give him a superiority over Englishmen in the representation of English scenes. We have no illiberal prejudices against foreign artists, and should be the first to recommend the purchase of their works for our public collections, but we think that when any great national commemoration is the subject, the employment of foreign artists is a desecration of the monument. It is thus also we view the employment of Marochetti at Glasgow. How differently would Titian, Murillo, Rubens, Rembrandt or Lebrun represent the English people in the performance of the same action—however great might be the skill of the artist, he would be wanting nationality. How are we ever to become a great nation in art, when we are deprived of the only opportunity of giving scope to the powers of our artists!

Wesleyan Chapel, Great Queen Street.—The small portico which has been attached to the front is completed.

British Museum.—A temporary communication has been opened through the Long Gallery, so that the visitor is now able to proceed all round the Museum. In the upper Egyptian room are two fine specimens of Egyptian sculpture in *intaglio rilevato*, highly deserving of attention.

Clifford.—On Monday the 23rd of November, the foundation stone of a new church about to be erected at Clifford, in the parish of Bramtram, in the West Riding of the county of York, was laid by Miss F. E. Fox, daughter of George Lane Fox, Esq., of Bramham Park. The ceremony was attended by many of the clergy and gentry in the neighbourhood. This church will be endowed with £1,500 by G. L. Fox, Esq., and the Dean and Chapter of Christ Church, Oxford, give £200 further endowment when the church is opened. It will be built by subscription in the neighbourhood and elsewhere, which has been liberally responded to. The design is furnished by Messrs. Atkinson, architects of York, to whose charge the building is intrusted. The church is intended to contain 300 persons in free pews, and there are no galleries. It is built in the form of a cross, with transepts; and a tower 70 feet high at the west end, and is of the pointed or early English style. The entire building is faced with free stone from the neighbourhood, and the cost when complete will be about £1050.

MISCELLANEA.

Cornish Steam Engines.—The number of pumping engines reported this month is 54. They have consumed 3193 tons of coal, and lifted 20 million tons of water 10 fathoms high. The average duty of the whole is, therefore, 53 million pounds lifted one foot high by the consumption of a bushel of coal. Richards's stamps at Wheal Vor works with hot condensing water. The boilers are being changed at Trelawney's engine, Wheal Vor, and are leaky at Tincroft; Wheal Prosper; Cargise; Taylor's, Woolf's, and Bawden's engines, Consols; and at Hocking's engine, United Mine.—*Lean's Engine Reporter, December 11.*

The Lake of Haarlem.—The King of Holland has just authorized the raising of an additional loan of three millions of florins for draining the Lake of Haarlem.

Proposed Suspension Bridge over the Haslar Lake at Portsmouth.—The usual calculation for the maximum load on each superficial foot of the platforms of suspension bridges is 70 lb.; but, as in the event of a crowd of persons assembling, the pressure may increase to nearly 100 lb. per foot, and by the passage of soldiers marching in regular time the strain may be greatly augmented, the projector assumed 200 lb. per superficial foot as the amount of load to which the platform might be subjected. The peculiar feature of this bridge is the substitution of cast iron chains for the wrought iron ones generally used. This deviation from the usual practice is adopted as a measure of economy, and with a view of increasing their stability and durability, cast iron being much less influenced by atmospheric action than wrought iron. Cast iron beams, when well proportioned, will bear a very considerable tensile strain. As these chains would be proved beyond the weight they are intended to bear, no doubt is entertained by the author of their security. The platform, which is formed of transverse iron girders, carrying cast iron plates three quarters of an inch thick, with dovetails falling into holes cast in the girders, is suspended by wrought iron rods 1½ inch square from two lines of chain only, as the strain is more easily brought to bear on them than on a greater number of chains. They are trussed laterally to prevent oscillation, and the balustrade is so constructed as to prevent the undulation so prejudicial to suspension bridges generally. To insure a perfect bearing, each pair of links of the chains are, in manufacturing, cramped together, and the holes bored out to receive the pins, which are turned to fit them accurately; they are of a larger size than usual, being four inches diameter, and a less number are employed. The piers on which the chains pass are of cast iron, 33 feet high above the level of the roadway.

The extreme length of the bridge is	632	feet.
The breadth of the roadway	17½	—
The clear waterway between the piers	300	—
The clear headway of the platform above the high water line	18½	—
Ditto ditto above low water line	33	—

The tension on the chains is calculated as equal to 991·4143 tons. To sustain this tension, the section of the chains is 256 square inches, and taking seven tons per square inch as the elastic limit of cast iron, the resistance of the chains will equal 1,792 tons, leaving a surplus of 800·6 tons after the calculated strain has been deducted from the real strength of the chains.—*Inventor's Advocate.*

STEAM NAVIGATION.

Messrs. Rennie are fitting their trapezoidal paddle-wheel to the *Africa*, a government steamer, instead of the common paddle-wheel, which has been heretofore used; this will form an excellent criterion of the comparative advantages of the two wheels. They are also fitting similar wheels to a vessel for the French government.

The Screw government have determined upon building a steamer for the purpose of trying the Archimedean screw; orders have been given to Messrs. Seaward for a pair of engines of 200 horse power each, for working the vessel.

A Gravesend steamer is on the stocks, which is stated will run from the Blackwall Railway to Gravesend within the hour. Messrs. Miller & Ravenhill have the construction of the engines in hand.

Rotary Engines.—Mr. Galloway is about applying a rotary engine of his invention to a new boat, for the purpose of working the screw without the necessity of using any intermediate wheels or gearing. The boiler is tubular, upon the locomotive principle. Messrs. Rennie are constructing the engines, which are now being put on board at their wharf at Blackfriars.—Another boat is being fitted with Bimns' patent rotary engines, of considerable power, and a tubular boiler, to work a wheel upon a new principle in the stern; the paddle-boards are suspended upon their axes, and allowed to work freely upon them without any stops, so that the paddle-board is always kept in a perpendicular position.

Launch of an Iron Steamer.—There was launched from Mr. Borrie's ship-building yard, Broughty Ferry, on Friday, 11th ult., an iron-built twin steamer, named the Princess Royal. This vessel has been built for the Tay Ferry Trustees, and is intended to ply between Dundee and Newport; her length on deck is 106 feet, by 34 feet in breadth, giving the extraordinary area on deck of 3604 square feet; she has been brought up to Dundee, and Mr. Borrie has commenced erecting her engines on board, which are of 80 horse power, and one in each of the hulls. The hulls are connected by the deck beams, and by six systems of transverse stays; the fastenings of these stays are placed within a few inches of the lead water line, for the more effectually maintaining the hulls in their true relative position; there is an intermediate space between the hulls, 10¾ feet in breadth, which extends the whole length of the vessel; there is only one paddle-wheel, and it works in this space nearly at the centre of the vessel, and is completely hid from view. When used as a ferry boat a twin steamer possesses many advantages, from her peculiar construction, over a single vessel; among these the most prominent are the great facility with which a twin steamer can take the quays from the absence of the paddle-wheels on the sides, great stability, easy motion in a cross-swell, great buoyancy, without having a great length and breadth of floors, and the sectional area of displacement not greater than what would obtain in a single vessel of the usual proportions. The form and finishing of this vessel are much admired, and will not fail to bring additional reputation to the contractor, whose eminence as an engineer is already fully acknowledged.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 27TH NOVEMBER TO 23RD DECEMBER, 1840.

Miles Berry, of Chancery-lane, Patent Agent, for "*certain improvements in looms for weaving.*"—Sealed November 27; six months for enrolment.

John Clay, of Cottingham, York, Gentlemen, and Frederick Rosenborg, of Sculcoates, in the same county, Gentleman, for "*improvements in arranging and setting up types for printing.*" November 27; six months.

John Condie, Manager of the Blair Iron Works, Ayr, Scotland, for "*improvements in applying springs to locomotive railway and other carriages.*"—November 27; six months.

George Holsworthy Palmer, of Surrey-square, Civil Engineer, and Charles Perkins, of Mark-lane, Merchant, for "*improved constructions of pistons and valves for retaining and discharging liquids, gases, and steam.*"—November 28; six months.

George Blaxland, of Greenwich, Engineer, for "*an improved mode of propelling ships and vessels at sea and in navigable waters.*"—November 28; six months.

Henry Bridge Cowell, of Lower-street, Saint Mary, Islington, Ironmonger, for "*improvements in taps to be used for or in the manner of stop-cocks, for the purpose of drawing off and stopping the flow of fluids.*"—December 2; six months.

James Robinson, of the Old Jewry, Manufacturer of Machinery, for "*a sugar-cane mill of a new construction, and certain improvements applicable to sugar-cane mills generally, and certain improvements in apparatus for making sugar.*"—December 2; six months.

Alexander Horatio Simpson, of New Palace-yard, Westminster, Gentleman, for "*an improved machine or apparatus for working pumps.*"—Communicated from a foreigner residing abroad. December 9; six months.

William Peirce, of George-street, Adelphi, Gentleman, for "*improvements in the preparation of wool, both in the raw and manufactured state, by means of which the quality will be considerably improved.*"—December 9; six months.

Charles Winterton Baylis, of Birmingham, Accounting-house Clerk, for "*an improved metallic pen, to be called the Patent Flexion Pen and Improved Penholder.*"—December 16; six months.

George Wildes, of the city of London, Merchant, for "*improvements in the manufacture of white lead.*"—Communicated by a foreigner residing abroad. December 16; six months.

James Davis, of Shoreditch, Engineer, for "*an improved mode of applying heat to certain steam-boilers.*"—December 16; six months.

John Steward, of Wolverhampton, Esq., for "*an improvement in the construction of piano-fortes, harpsichords, and other similar stringed musical instruments.*"—December 16; six months.

James Molyneux, of Preston, for "*an improved mode of dressing flax and tow.*"—December 16; six months.

Charles Bolton, of Farringdon-street, Gas Engineer, for "*a certain improvement in gas meters.*"—December 16; six months.

Hugh Graham, of Bridport-place, Hoxton, Artisan, for "*a new mode of preparing designs and dyeing the materials to be used in the weaving and manufacture of Kidderminster carpets, and for producing patterns thereon, in a manner not before used or applied in the process of weaving and manufacturing such carpets.*"—December 16; six months.

Joseph Beattie, of Portland-place, Wandsworth-road, Lambeth, Engineer, for "*certain improvements in locomotive engines, and in carriages, chairs, and wheels, for use upon railways, and certain machinery for use in the construction of parts of such inventions*"—December 16; six months.

Andrew Pruss D'Olszowski, of Ashley-crescent, Gentleman, for "*a new and improved level for ascertaining the horizon, and the several degrees of inclination.*" Communicated by a foreigner residing abroad.—December 16; six months.

William Tudor Mabley, of Wellington-street North, Mechanical Draftsman, for "*certain improvements in producing surfaces to be used for printing, embossing, or impressing.*"—December 17; six months.

Abraham Alexander Lindo, of Finsbury-circus, Gentleman, for "*improvements to be applied to railways and carriages thereon, to prevent accidents, and to lessen the injurious effects of accidents to passengers, goods, and railway trains.*"—December 18; six months.

Elias Robinson Handcock, of Birmingham, Esq., for "*certain improvements in mechanism applicable to turn-tables, for changing the position of carriages upon railroads, for furniture and other purposes.*"—December 18; six months.

Richard Coles of Southampton, Slate Merchant, for "*improvements in machinery for manufacturing tanks and other vessels of slate, stone, marble, and other materials, and in fitting and fastening such materials together.*"—December 23; six months.

Benjamin Baillie, of Henry-street, Middlesex, for "*improvements in locks, and the fittings and fastenings thereto belonging.*"—December 23; six months.

John Brumwell Gregson, of Newcastle-upon-Tyne, Northumberland, Soda-water Manufacturer, for "*improvements in pigments, and in the preparation of the sulphates of iron and magnesia.* December 23; six months.

Frederick Payne Mackelean, of Birmingham, and James Murdoch, of Hackney-road, Civil Engineers, for "*certain improvements of or belonging to tables, a portion of which is applicable to other articles of furniture.*" Partly communicated by a foreigner residing abroad.—December 23; six months.

George Thornton, of Brighton, Civil Engineer, for "*certain improvements applicable to railways, locomotive engines, and carriages.*—December 23; six months.

John Dickinson, of Bedford-row, Esq., for "*certain improvements in the manufacture of paper.*"—December 23; six months.

David Walther, of Angel-court, Throgmorton-street, Merchant, for "*certain improvements in the methods of purifying vegetable and animal oils, fats, and tallows, in order to render those substances more suitable to soap-making, or for burning in lamps, or for other useful purposes, part of which improvements are also applicable to the purifying of the mineral oil or spirit commonly called petroleum or naphtha, or coal oil, or spirit of coal tar.*"—December 23; six months.

John Jones, of Leeds, Brush Manufacturer, for "*improvements in carding engines for carding wool and other fibrous substances.*"—Communicated by a foreigner residing abroad. December 23; six months.

Joseph Barker, of Regent-street, Artist, for "*improvements in gas meters.*"—December 23; six months.

TO CORRESPONDENTS.

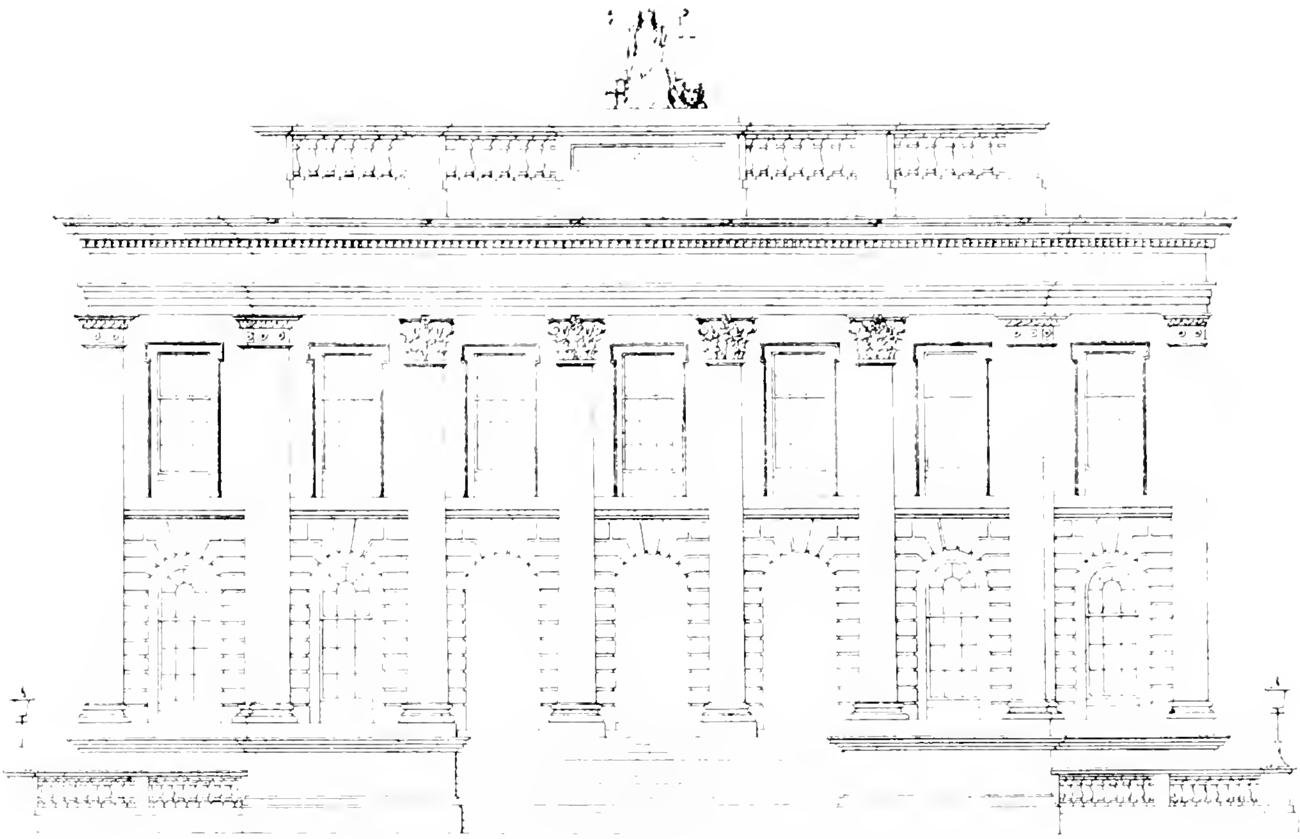
The drawings of the new town hall of Ashton-under-Lyne will appear next month.

Additional information on the Reform Club will be given when the building is entirely finished.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.



ELEVATION OF THE NEW TOWN HALL, ASHTON-UNDER-LYNE

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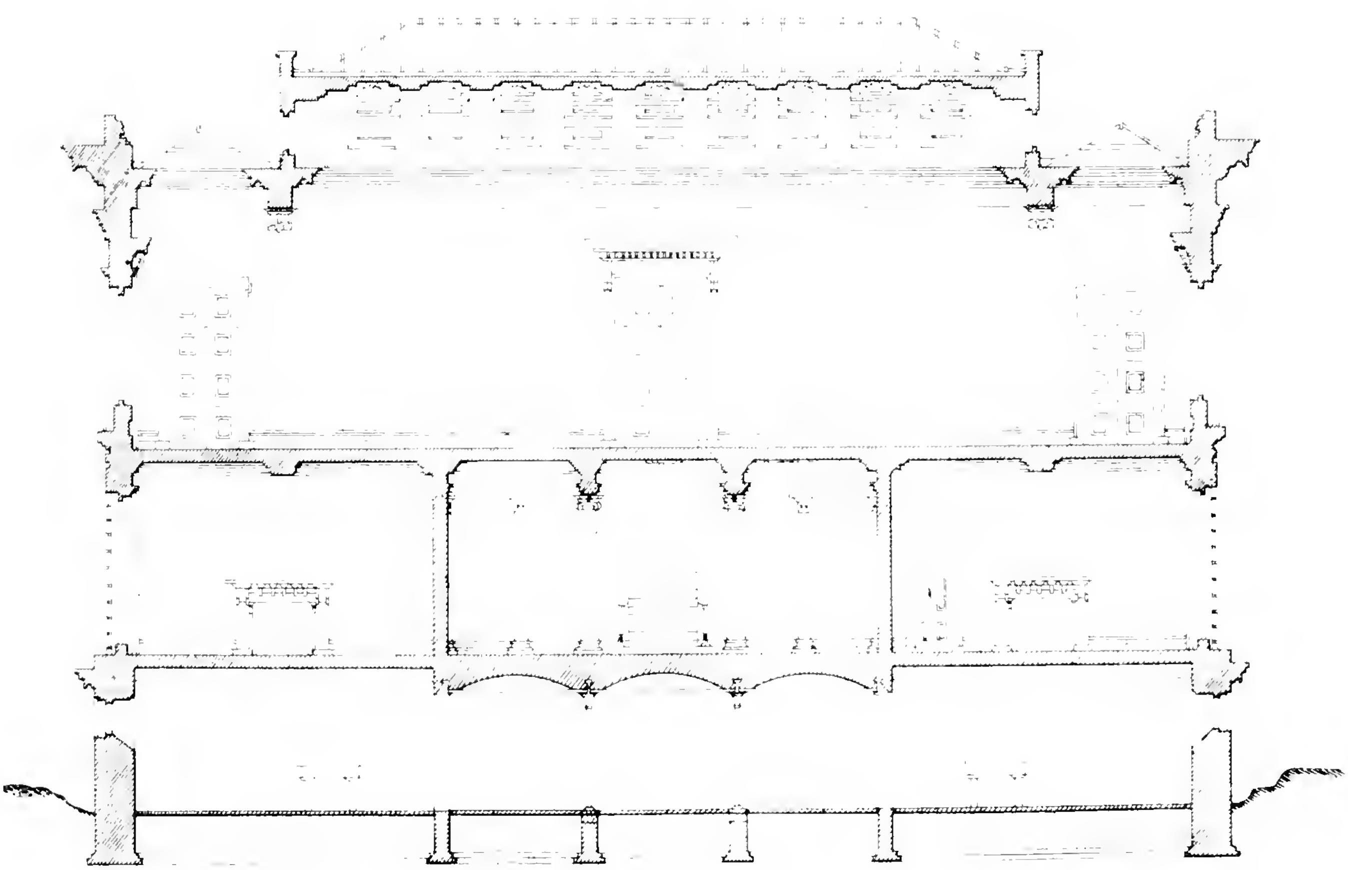

LONGITUDINAL SECTION

SCALE OF FEET

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NEW TOWN HALL, ASHTON-UNDER-LYNE.

Architects, Messrs. Young and Lee.

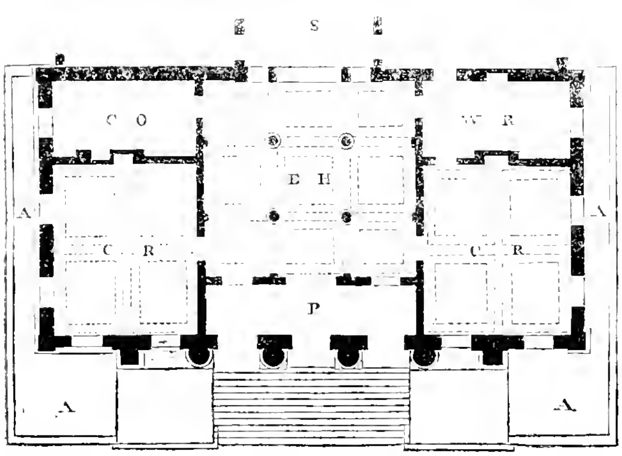
With an Engraving, Plate II.

A brief description of this building appeared in the No. for last July. It is in the Roman style of architecture, and consists in front of an attached Corinthian colonnade *in antis*, surmounted by a balustrade of the same order, which forms a parapet to the centre of the façade, and is crowned by a group of sculpture. The wings consist of a single interpilaster, and terminate above with a plain parapet. The two flanks of the building are alike; and consist simply of three windows in length, each similar to those in front, with antæ at the corners only. The attic wall with its cornice is also continued round the flanks. The internal arrangements, it will be seen, demanded that the front wall should form an uninterrupted line, and be pierced with windows along its entire length; and it was therefore considered preferable to have attached columns—an arrangement adopted in the Erectheium at Athens. The order itself is divided into two stories, and is elevated upon a lofty stylobate. Its proportions are chiefly taken from the Pantheon at Rome. A dentil cornice, instead of one with modillions, is used to save expense.

The design although making no pretensions to originality, is in keeping with the style adopted, and does credit to the architects, Messrs. Young and Lee of Manchester.

This building, erecting from designs by one of the architects engaged, Mr. William Young, of Manchester, is now on the point of being *roofed in*. It stands on the north side of the new market-place, Ashton-under-lyne; a town which, compared with its size, may be said to be rich in public and private buildings of importance. Many of these are of a very tasteful character, and certainly reflect great credit on the spirit of the inhabitants. The main portion of the edifice before us, being that shown on the plan, is entirely faced with tooled Ashlar, from the quarries of Saddleworth, in Lancashire, and the remainder of the building faced throughout, with stone from the neighbourhood, neatly hammer-dressed.

Ground Plan.



Scale 30 feet to an inch.

A, Area. P, Piazza, 33·0 × 8·6. E H, Entrance Hall, 33·0 × 31·0. S, part of Staircase. C R, Committee Rooms, 26·0 × 24·0. C O, Collector's Office, 13·0 × 24·0. W R, Waiting Room, 24·6 × 13·0.

The plan will describe the principal floor, which is 16 feet high in the clear, and comprises an entrance hall, approached by a *piazza* in front, and arranged as a triple colonnade of the Ionic order. A handsome geometrical stone staircase, 24′×21′ leads from this to the first floor of the building, whose principal feature is a large public room extending over the entire space shown in the plan, 83 ft. in length by 40 ft. in width, and 28 feet high to the cove. The ceiling, as will be seen by the accompanying section, is divided longitudinally into a centre and two side compartments, the former of which is a segmental *cove* with double panels or *lacunars*, the upper ones being enriched with open rosettes, screening the ventilators in the roof. To afford light and give effect to these and the members of the ceiling generally, a circular or wheel window of an ornamental character is placed in each *tympanum* or plane extremity of the *cove*. The cornice and fascia round the room are entirely plain, and where the latter crosses the ceiling transversely, dividing the three compartments before mentioned, ornamental brackets or cantilevers are introduced, connecting the soffit with the opposite walls. The doors and windows of the room are finished with architraves and cornices with plain consoles. Attached to it is a suite of ante and retiring rooms. It is intended for the use of public meetings, assemblies, &c., as well as for holding petty sessions; for this latter purpose it communicates on one side by a circular stone staircase with the police office on the ground floor, and a range of stone lock-ups in the basement. All the doors in the entrance hall and staircase, have architraves and cornices in keeping with the finishings of the large room. The whole of the timbers throughout are Kyanized. This building will be erected for *less* than the sum specified in the architects' estimate.

ENGINEERING HONOURS AND REWARDS.

It seems to be an admitted fact that England is, of all countries, that in which the fewest and most trifling honorary distinctions are conferred upon men of science—a proposition in which our readers are doubtless fully prepared to express their acquiescence, as one which they have always heard uncontroverted and deplored. For this cause our men of science have complained, and the policy of our government has been called in question, for certainly all history and experience attest to us that honorary distinctions are those rewards which are most grasped at, and most fiercely contended for. It was for a perishable crown of leaves from the neighbouring trees that kings entered the lists at Olympia, and Grecian heroes exerted all their powers. It is with such feeling that the man of science looks forward to a distinction which is to herald him in society, and to be perhaps the only reward of the labours of years, and of the greatest triumphs of the mind.—The astronomer, the geologist, the mathematician, the naturalist has few golden premiums to look forward to, a scanty professorship or a death-bed pension is the limit of his hopes, and he clings the more to a recompense which is but an acknowledgment of services, for which he can obtain no pay. The system is good, and we do not wonder that our countrymen strive for its extension, we are only surprised that they should make invidious comparisons as to their native land, when a little consideration would teach them that their lot is not so much to be contemned. Napoleon gave, it is true, his counties and his baronies, his grand crosses and his stars pretty liberally—the same may be said of other governments—now we have to ascertain what our own authorities have done in this respect. M. Arago complains most truly that we did not make Watt and others peers, but both he and most others seem neither to have reflected upon the reason for this omission, nor to have noticed what really has been done. Political power is one thing, honorary distinction another, and in no country that we are aware of, although isolated instances occur, is it a recognized principle to invest scientific men with political functions, for (with exceptions of course) no class perhaps could be found less adapted for their competent exercise. The special world of the student is not the great world of the politician, it is a sphere brilliant, but inferior, having its own laws, and pursuing its own revolutions. The chemist has been educated for his laboratory, the astronomer for his watch-tower, the naturalist for his cabinet, and so also must the politician be educated for his duties, and accustomed to their performance. This certainly is one reason why in England the peerage is not to be reckoned among scientific rewards, but there is also another, which however it may arise from prejudice, is equally authorised by precedent—the peerage of England is a rank, which whether it be held by the duke or the baron, in the scale of courts is received as princely, which coequalizes with the grandeeship of Spain, and the principality of the Roman empire—a rank similar in fact to Napoleon's dukes. Now, however it ought to have been—we know that Monge, Cuvier, and the other illuminati of the empire never were created dukes, but received a lower title, and were not, except in extraordinary cases, invested with political power. The ranks which they received, in the comparative scale of French and English society, are very little more than our knighthood, if so much, for although the counts and barons of the empire were few in number, yet France so swarms with counts and barons of other kinds that they form a very squirearchy for multitude. The same may be said of the Prussian barony and councillorship of state. Admitting then that knighthood is by precedent a competent reward, we think it will be found that England has not been behind hand, but has rather gone farther by giving, as in the case of baronetcies, an honorary title of even a higher kind. If we look only at the last half century, we shall find a multitude of distinctions given which in our opinion far outbalance any exertion of other nations. The law part[illegible] so much of a political profession that we need scarcely allude to the honours which devolve upon it, extending even to the peerage, in which it has founded so many great houses. Medicine is scarcely less cared for, as in one shape or another it has scarcely less at the present moment than a score of Sirs, many of them baronets, and since the commencement of the present century it has numbered more nearly half a hundred than any lower number. The artists come next in number, their president is always knighted, and their several departments of painting, sculpture, architecture and engraving have nothing to complain of, having half a score knighthoods among them, six in the Royal Academy. We will now skim over some of the other classes which at different times in the last fifty years have been noticed, and of course in such a list, we must be guilty of many omissions. We find of astronomers and philosophers Sir Joseph Banks, Bart., G.C.B. and Privy Councillor, Sir W. Herschel, Sir John Herschel, Bart., Sir James Hall, Bart., Sir David Brewster, Sir John Robison, &c.; of chemists, Sir Humphry Davy, Bart.; of naturalists, Sir James Edward Smith, Sir William Jackson Hooker, &c.; of agriculturists, Sir John Sinclair, Bart.; of musicians, Sir George Smart, Sir John Stevenson, &c. Antiquaries have as heralds and keepers of records political opportunities of promotion, and accordingly come off pretty well, they number Sir Wm. Woods, Sir W. Betham, Sir Harris Nicolas, Sir Nicolas Carlisle, Sir Henry Ellis, Sir Gardner Wilkinson, &c. Travellers and discovers also have a similar relation, and boast their Sir Edward Parry, C.B., Sir John Franklin, C.B., Sir John Ross, C.B., Sir Alexander Burnes, Sir James Alexander, &c. Literary men have not been so lucky, Sir Walter Scott's baronetcy being their principal.

We think we have thus run over a list which will satisfy any reasonable man that affairs are not so badly off in old England, and that in the country where William Cobbett rose from the *impasse* of the army to share in the legislation of the greatest empire of the world, that there is something to be looked forward to by every man who has talents to do good and diligence to exert them.

We have thus defended our authorities from the general charge of neglecting scientific rewards, but we cannot so easily acquit them of indifference towards a profession which has the fairest claim upon their attention. The military engineers come in with the rest of the army, the naval engineers have had their Sir Robert Seppings, and Sir Edward Symonds, but the civil engineers have received only one knighthood, and that too conferred for what was considered an architectural labour. We think that the profession has just ground to complain of this, they are rising in public estimation, possess good general rank, have performed most important public services, and yet have been passed over as to the most coveted reward. The Institute has received a royal charter, engineering is a recognized educational faculty, for which a regius professorship has been founded, honorary degrees have been conferred upon its members, and the president has received a seat in the senate of the great university of the empire, so that certainly as far as qualification goes, there is not the least ground for this holding back of favour. Two years ago we had to complain of this, and we are sorry to renew our murmurs now. In other professions there are certain defined offices, the holders of which generally receive honours, and we do not see why it should not be so with the engineers. The Presidents of the Royal Society have had a baronetcy, as also the President of the Royal Society of Edinburgh, the President of the Linnæan Society, and the President of the Royal Academy knighthood. The government lawyers, medical men, painters, sculptors, architects, musicians, heralds, naval engineers, &c., both in England and Ireland are generally knighted, so that so far from a precedent being wanted, an omission only seems necessary to be supplied. If we look at our triumphant progress in railways, bridges, steam navigation, &c., in which we are almost without rivals, we think that there can be no difficulty in selecting such of the authors of them as are fully deserving of any honour the government can bestow. We think the President of the Institute, and the government engineer both in England and Ireland should always be knighted, and we think the same honour should be conferred on the most distinguished railway and marine engineers.

James Watt has had more public statues erected to him than the Duke of Wellington. The nation has expressed its opinion, let its representatives confirm it.

A Cornish engine has been recently erected on the New Southwark Water Works, in the Battersea Fields, by Mr. W. West, and manufactured by Messrs. Harvey & Co., of Hayle Foundry, on the same principle as that erected by those gentlemen on the East London Water Works, at Old Ford, and described in the Journal. Her cylinder is 64 inch diameter, length of stroke 10½ ft. in the cylinder, and 10 ft. in the pump, working a 32 inch plunger pole, with the patent valves by Messrs. Harvey & West, which are so constructed, and the operation so easy, that it would be difficult to persuade a common observer of the existence of a valve therein.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXIII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Speaking of Versailles, Theodore Hook says: "as to its extent, its galleries, its saloons and all that sort of thing, it is internally striking; but any thing more hideously frightful as a building—speaking of it architecturally—never was seen. The front, as you approach it from Paris, is indescribably mean. The garden front is bald and graceless—the associations connected with it, and the splendour of its internal decorations may and do give it a palatial character: but it is an exceedingly ugly affair." This criticism is not at all too severe, for the exterior is in fact the very maximum of littleness,—so far miraculous as it shows that it is possible to contrive a building of great extent and enormous cost that shall nevertheless be altogether destitute of effect, and possess no more grandeur—that is, artistical grandeur and dignity, than a huge barrack of the same size. So far Versailles well deserves to be styled—as it has been before now, one of the *wonders* of the world.

II. Among the qualifications usually insisted upon as requisite to an architect—of some of which, by the by, the necessity is not very apparent—we do not find enumerated the one which of all others would seem to be the most indispensable, that is, when we come to something more than mere building and construction, and consider architecture as a fine art. The qualification thus *accidentally* overlooked, as if it were the least important of any,—something which it is very well to possess, but which an architect can contrive to make shift without, is what for want of a definite term in our own language to express it, we must call "*Kunstsinn*," which word implies a good deal more than our English "*Taste*." It would seem that this and this alone distinguishes the architect from the builder—taking those names not in their professional and technical meaning, but in the sense of artist, and non-artist, or at best artist at second hand, a mere plodder who stands in the same degree of relationship to the other that a mechanical rhymer, a scribbler of Album verses does to a true poet, *cui mens divinior*. Heaven knows! it is not every one who confidently writes himself architect, that has legitimate pretensions, or indeed, any pretensions at all to such title, if it is to be taken in its nobler meaning. Which being the case, it is by no means very difficult to understand why so many of them affect to hold artistical talent in their profession so very cheap, treating it as something of an altogether secondary consideration. Nothing is more common than to hear such people exclaim "O! that is all mere matter of taste and opinion." Most true, yet it is not every one who can distinguish between good and bad taste,—much less who is able to display superior taste in his own productions. It is true, taste is not absolutely indispensable on every occasion: nevertheless it is of paramount importance in edifices laying claim to be considered works of fine art, for in such case wanting æsthetic value, they want what, in that character is most essential to them. So far therefore, there is a very material difference between being a most excellent builder and an accomplished architect—and master of the art: not that excellence in construction is no merit in itself, or one that may be dispensed with at pleasure, but it is one which is negative as far as the æsthetic value of an edifice is concerned. Health and strength of body do not constitute beauty: in themselves, indeed, they are more essential requisites, but still they are distinct qualities from the other, although they, to a certain extent, contribute to it. In like manner does good building—able construction contribute to the value of an architectural production, but it cannot be received as an equivalent for æsthetic beauty, where this latter exists not, or perhaps, is most obviously and offensively deficient. This distinction between the Useful—the Necessary, and the Beautiful ought never to be lost sight of: least of all in these our mechanical, engineering times, when they are apt to be confounded together; and when it not unfrequently happens that mere utility and economy alone are considered all in all, and all-sufficient; and taste to be something which it is as well to have as not, provided it comes of itself, and can be had without trouble, but which is not worth any study or pains to secure it.

III. Architects are somewhat unjust and inconsistent in depreciating a class of artists whom they themselves have called into existence, namely, those styling themselves Decorators; for the latter would certainly not possess the control they now do, were it not that the others have, in a manner, surrendered up to them one entire and certainly very important province of their own art,—that one, in fact, where alone there is room for the display of aught like taste or invention in domestic architecture generally. On this last account, it might be thought that instead of neglecting—we might say abandoning, that particular department of architectural design, the profession would apply themselves to it more especially, as affording the majority of them almost the only opportunities they can hope for, of displaying any ability as artists. So very far, however, is it from being the case that, on the contrary, all relating to the interior arrangement and decoration of private houses, seems to be quite overlooked in an architect's professional studies, and treated as if scarcely belonging to them. Very rarely indeed is any subject whatever of the kind to be met with at any of the exhibitions at the Academy; while even those who publish designs expressly purporting to be studies of domestic architecture, and to furnish ideas for those who intend to build, are equally shy of submitting any examples of interior fitting up and embellishment, confining their attention, as far as interior is concerned, merely to adjustment of the plan; and again in regard to this last, satisfying themselves with doing no more than consulting ordinary convenience, and avoiding palpable defects; but without aiming at any thing further—at any kind of effect, either as regards the general distribution or the individual rooms. The consequence is that when the architect has completed his task, and taken his leave, the owner finds all in the rooms in his house—with the exception perhaps of vestibule and corridors—quite in an unfinished state—with bare, blank walls. Of course then the decorator—who perhaps may be no better than a mere paperhanger—must be called in, to give the finishing touches to the rooms, before the upholsterer comes in his turn, with his readymade taste:—and it is well if between decorator and upholsterer, the architecture—that is, supposing there to be any at all —is not fairly smothered. Architects—at least ninety-nine out of a hundred, will say that such finical matters as those of mere fitting up and ornament, do not at all belong to them, nor have formed any part of their studies. The consequence is that the whole department of taste in regard to such matters, is consigned over to a class of persons who have generally but a very poor stock of that article, and with whom what is most expensive of its kind, and the newest in its fashion, is always sure to be the tip-top of elegance.

ON THE STATE OF THE ARTS IN ITALY.

Brief Observations on the State of the Arts in Italy, with a short account of Cameo-cutting, Mosaic work, Pietra Dura, and also of some of the Domestic Arts and Mechanical Contrivances of the Italians. By Charles H. Wilson, Esq., Architect, Edinburgh, A.R.S.A., and M.S.A. *Read before the Society of Arts in Edinburgh, Nov. 1840, and printed in the Edinburgh New Philosophical Journal, for January 1841.*

I feel that I ought to apologise to the Society for bringing before it a paper of this nature, which contains no description of any new art or discovery, but which may rather be described as being little more than a *catalogue* of arts and practices, most of which are of great antiquity. I hope that such a paper may be deemed admissible. As far as my individual opinion goes, I would say that it would be very desirable if several papers were read every session containing as distinct accounts as could be obtained of the state of the arts and sciences, with reviews of the progress made in them in different Continental countries every year. That such papers would be useful in various points of view appears to me sufficiently obvious; those who have neither leisure nor opportunity to inquire for themselves would by this means obtain a great deal of valuable and interesting information; our efforts to excel in the arts and sciences would be stimulated; and, above all, I think that, whilst our national vanity would be advantageously chastened, feelings of respect and esteem, founded on a knowledge and just appreciation of the merits of other nations, would beyond all other influences lead to international amity. Feelings like these have already been happily nourished by the amicable intercourse of literati of different nations: the course which I advocate would tend to the further diffusion of such sentiments amongst all classes.

I cannot, without presumption, imagine for a moment that the paper which I now bring before you can deserve to be considered one of such a series. I went abroad at a very early age, and my time was entirely given up to the study of the art to which I had devoted myself, and which every thing around me tended to increase my love of. The collateral studies of the youthful artist are naturally those connected with his art, and are greatly more extensive in Italy, from many favourable circumstances, than in Scotland, and the brief allusion which I have made to them and to the time of life when I lived abroad, is meant as an apology for the meagreness of the details which I humbly bring under you notice.

Any comment on the political condition of Italy would be out of place in a paper to be read here, although a distinct apprehension of it would be necessary previously to any inquiry into the state of her arts and sciences, and also to enable us justly to appreciate the great merits of Italian philosophers and literati, who, despite of adverse circumstances, so greatly distinguish themselves; but to so slight a sketch of the *arts* of Italy as that I am about to offer, any lengthened observations are not so necessary. Whatever may be our opinion of Austrian principles of government, and of Austrian influence in Italy, all who have visited the Italian territories of that power, must, I think, acknowledge that Lombardy is greatly in advance of the independent states, and in no part of Europe, Scotland excepted, are there more numerous schools for the instruction of all classes of the people. As the traveller advances southward, with nominal independence political degradation increases, and the general character of the people is lowered. We can feel no other emotions than those of regret for the prostration of Italy; but if we examine into the customs of the Italians, we shall every where find expressive indications of ancient power and refinement, and pleasing proof that, where civilization and its attendant sciences and arts has once held extensive sway, advantages are secured of which it is almost impossible, or at any rate very difficult, to deprive a people.

I shall commence with a brief notice of the art of painting in Italy: this fine art has gradually declined, and there seems to be no indication at present of its recovery. It is trammelled by academic system. The Roman school is distinguished by a cold affectation of classic purity, and a want of energy and nature in all its productions; but, whilst we avoid the errors into which it has fallen, we should not allow these, and the difference of its practice from our own, to blind us to its good qualities; many Roman artists draw exceedingly well, and they evince this power in the large and fine cartoons which they are in the habit of executing before commencing a picture. But if the student in this country does not draw long enough, which I think is the case, the Italian student, in acquiring his mastery of the crayon, seems to forget that he is ever to use the brush; and the Italian artists rarely prove even tolerable colourists, whilst their prejudices as to the adoption of many necessary processes in painting, and which were unquestionably in use amongst their great predecessors, are invincible. This was illustrated in an amusing manner one day in the Florence gallery. An Italian artist was busy copying a Venetian picture, and my late friend Mr. James Irvine, happening to look at his work, remarked to him that he never could hope to imitate the brilliancy of the original without glazing. "I know that," said the Italian, "but I won't glaze."

At Florence, painting is in much the same state as at Rome; of late some artists have endeavoured to add richness in colour to the correctness of their drawing, but they have only succeeded in arranging on their pictures in brilliant juxtaposition rainbow colours, without attaining that harmonious effect which marks the works of their great predecessors. At Naples, painting is at a low ebb; at Genoa, lower still; at Venice, it is little better; but at Milan it reckons amongst its professors clever men in some departments of the art.

Fresco painting is still pursued in Italy, but with most success by the Germans. I wish to avail myself of this occasion to do homage to the extraordinary merits of the masters of this distinguished school; in looking on their works, we cannot but regret that greater encouragement is not given to the highest department of painting in this country; in those which are encouraged, our artists excel; and we may, I think, therefore, justly conclude that ability would soon be found to execute works of the noblest description.

Engraving may appropriately be considered after painting. You are all, doubtless, well acquainted with the great names which have lately marked the progress of this art in Italy; most of these distinguished artists are now dead. Several of Raphael Morghen's pupils are much esteemed, the best of whom are established at Milan; many very fine and important works have been lately finished or are now in progress. Messrs. Ludwig Gruner and Rusweigh, both Italianized Germans, promise to revive the style of Marc Antonio with success.

The Italian engravers are most successful in their works from historical pictures; but a practice which they follow is, in my opinion, calculated to prevent their imitating with fidelity the style and feeling of the artist whose production they copy. They engrave from highly finished chalk drawings copied from pictures by artists who devote themselves to this branch: however faithfully these may apparently copy, it is certain that their drawings will, to a certain extent, exhibit their peculiarities of mind and feeling, and, as the engraving must likewise so far be marked by the style of its author, the process is not favourable to the production of engravings of a faithful character.

It is but fair to mention that this practice is forced upon the Italian engraver, as he can neither transport gallery pictures nor frescoes to his study.

The landscape engravings of Italy are not successful. Frigid imitators of Woollet in general, their works are far inferior to those of that admirable master.

Sculpture is certainly the art which stands highest in Italy. Canova rescued it from the infamy into which it had sunk, and his genius at once raised it to excellence. If I say that that immortal artist has worthy successors amongst his countrymen, I express, as strongly as possible, a favourable opinion of the state of the art. If we are to term that the Roman school of sculpture which reckons amongst its professors all the great sculptors of various nations who make the Eternal City their fixed place of residence, then we must, I think, hold that it is the first school existing. England is worthily represented in that united school. I shall not venture upon any comparison between it and our present British school: but it is an important fact, and to its honour, that, before Canova resuscitated sculpture in Italy, England could boast a succession of very eminent sculptors. I may mention the estimation in which our great Flaxman is held in Italy. "Flaxman," said a distinguished artist to me on one occasion, "was the greatest sculptor the world has known since the time of the Greeks;" and this opinion is very general in Italy. I touched shortly on the state of painting in the different Italian capitals. I shall pursue the same course with sculpture, but more briefly still, merely remarking that, with one or two exceptions, there are no Italian sculptors of eminence out of Rome.

In connection with the arts of painting and sculpture, we may now consider mosaic work and cameo-cutting as practised in Rome. The art of mosaic work has been known in Rome since the days of the republic. The severe rulers of that period forbade the introduction of foreign marbles, and the republican mosaics are all in black and white. Under the empire the art was greatly improved, and not merely by the introduction of marbles of various colours, but by the invention of artificial stones, termed by the Italians *smalti*, which can be made of every variety of tint.

This art was never entirely lost. On the introduction of pictures into Christian temples, they were first made of mosaic: remaining specimens of these are rude, but profoundly interesting in a historical point of view. When art was restored in Italy, mosaic also was improved, but it attained its greatest perfection in the last and present century. Roman mosaic, as now practised, may be described as being the production of pictures by connecting together numerous minute pieces of coloured marble or artificial stones: these are attached to a ground of copper by means of a strong cement of gum mastic, and other materials, and are afterwards ground and polished as a stone would be to a perfectly level surface: by this art not only are ornaments made on a small scale, but pictures of the largest size are copied. In former times the largest cupolas of churches, and not unfrequently the entire walls, were encrusted with mosaic. The most remarkable modern works are the copies which have been executed of some of the most important works of the great masters for the altars in St. Peter's. These are in every respect perfect imitations of the originals; and when the originals, in spite of every care, must change and perish, these mosaics will still convey to distant ages a perfect idea of the triumphs of art achieved in the fifteenth century. The government manufactory in Rome occupies the apartments in the Vatican which were used as offices of the Inquisition. No copies are now made, but cases of *smalti* are shown, containing, it is said, 18,000 different tints. Twenty years were employed in making one of the copies I have mentioned. The pieces of mosaic vary in size from an eighth to a sixteenth of an inch, and eleven men were employed for that time on each picture.

A great improvement was introduced into the art in 1775 by the Signor Raffaelli, who thought of preparing the *smalti* in what may be termed fine threads. The pastes or *smalti* are manufactured at Venice in the shape of crayons, or like sticks of sealing-wax, and are afterwards drawn out by the workman at a blow-pipe, into the thickness he requires, often almost to a hair, and now seldom thicker than the finest grass stalk. For tables and large articles, of course, the pieces are thicker; but the beauty of the workmanship, the soft gradation of the tints, and the cost, depend upon the minuteness of the pieces, and the skill displayed by the artist. A ruin, a group of flowers or figures, will employ a good artist about two months when only two inches square, and a specimen of such a description costs from 5*l.* to 20*l.*, according to the execution; a landscape, six inches by four, would require eighteen months, and would cost from forty to fifty pounds. This will strike you as no adequate remuneration for the time bestowed. The finest ornaments for a lady, consisting of necklace, ear-rings, and brooch, cost forty pounds. For a picture of Paestum, eight feet long, and twenty inches broad, on which four men were engaged for three years, 1,000*l.* sterling was asked.

I shall now notice the mosaic work of Florence, before touching on cameo-cutting. It differs entirely from Roman mosaic, being composed of stones inserted in comparatively large masses: it is called work in *pietra dura*. The stones used are all more or less of a rare and precious nature. In old specimens the most beautiful works are those in which the designs are of an arabesque character. The most remarkable specimen of this description of pietra dura is an octagonal table in the *Gabinetto di Baroccio*, in the Florence Gallery. It is valued at 20,000*l.* sterling, and was commenced in 1623 by Jacopo Dutelli, from designs by Ligozzi. Twenty-two artists worked upon it without interruption till it was terminated in the year 1649. Attempts at landscapes, and the imitation of natural objects, were usually failures in former times, mere works of labour, which did not attain their object; but of late works have been produced in this art, in which are represented groups of flowers and fruit, vases, musical instruments, and other compatible objects, with a truth and beauty which excite the utmost admiration and surprise. These pictures in stone are, however, enormously expensive, and can only be seen in the palaces of the great. Two tables in the Palazzo Pitti are valued at 7,000*l.*, and this price is by no means excessive. These are of modern design, on a ground of porphyry, and ten men were employed for four years on one of them, and a spot is pointed out, not more than three inches square, on which a man had worked for ten months. But Florentine mosaic, like that of Rome, is not merely used for cabinets, tables, or other ornamental articles: the walls of the spacious chapel which is used as the burial-place of the reigning family at Florence are lined with pietra dura, realizing the gem-encrusted halls of the Arabian tales. Roman mosaic, as we have seen, is of great value as an ally to art: but Florentine mosaic can have no such pretensions, and time and money might be better bestowed. The effect is far from pleasing in the chapel I have alluded to, and I think that the art might be advantageously confined to the production of small ornaments, for which it is eminently adapted.

An imitation of the pietra dura is now made to a great extent in Derbyshire, where the Duke of Devonshire's black marble, said to be quite equal to the famous Nero Antico, is inlaid with malachite, Derbyshire spars, and other stones: but the inlaying is only by veneers, and not done in the solid as at Florence. This, with the softness of the materials, makes the Derbyshire work much cheaper, and yet for a table, twenty to twenty-four inches in diameter, thirty guineas is asked. Were a little more taste in design and skill in execution shewn, the Derbyshire work might deserve to be more valued, as the materials, especially the black marble, are beautiful.

I shall now return to cameo-cutting. This art is also of great antiquity, and is pursued with most success in Rome, where there are several very eminent artists now living. Cameos are of two descriptions, those cut in stone, or *pietra dura*, and those cut in shell. Of the first, the value depends on the stone, as well as in the excellence of the work. The stones most prized now are the oriental onyx and the sardonyx, the former black and white in parallel layers, the latter cornelian, brown and white: and when stones of four or five layers of distinct shades or colours can be procured, the value is proportionably raised, provided always that the layers be so thin as to be manageable in cutting the cameo so as to make the various parts harmonize. For example, in a head of Minerva, if well wrought out of a stone of four shades, the ground should be dark grey, the face light, the bust and helmet black, and the crest over the helmet brownish or grey. Next to such varieties of shades and layers, those stones are valuable in which two layers occur of black and white of regular breadth. Except on such oriental stones no good artist will now bestow his time: but, till the beginning of this century, less attention was bestowed on materials, so that beautiful middle-age and modern cameos may be found on German agates, whose colours are generally only two shades of grey, or a cream and a milk-white, and these not unfrequently cloudy. The best artist in Rome in *pietra dura* is the Signor Girometti, who has executed eight cameos of various sizes, from 1½ to 3½ inches in diameter, on picked stones of several layers, the subjects being from the antique. These form a set of specimens, for which he asks 3,000*l.* sterling. A single cameo of good brooch size, and of two colours, costs 22*l.* Portraits in stone by those excellent artists Diez and Saulini may be had for 10*l.* These cameos are all wrought by a lathe with pointed instruments of steel, and by means of diamond dust.

Shell cameos are cut from large shells found on the African and Brazilian coasts, and generally show only two layers, the ground being either a pale coffee-colour or a deep reddish-orange: the latter is most prized. The subject is cut with little steel chisels out of the white portion of the shell. A fine shell is worth a guinea in Rome. Copies from the antique, original designs, and portraits, are executed in the most exquisite style of finish, and perfect in contour and taste, and it may be said that the Roman artists have attained perfection in this beautiful art. Good shell cameos may be had at from 1s. to 5s. for heads, 3s. to 1l. for the finest large brooches, a comb costs 10l., and a complete set of necklace, ear-rings, and brooch cost 21l. A portrait can be executed for 4l. or 5l., according to workmanship.

Having now touched upon those minor arts which have an intimate connection with painting and sculpture, I shall make a few observations on architecture, and the constructive and decorative arts which are connected with that science, but this I must do very briefly indeed, as otherwise I should occupy too much of the time of the Society.

The architects of Italy have but little scope for a display of ability, as the population is not on the increase, but, on the contrary, except in parts of the Austrian States, has shrunk away from the number required to occupy the palaces, villas, and houses which already exist both in town and country; and this is painfully proved by the number of empty and dilapidated edifices. The various buildings which belong to Government, the churches, colleges, and hospitals, have generally been built on a scale of magnificence which has never been excelled, in some instances never equalled, in other countries, but all betoken more or less the same melancholy decline. By this observation I do not mean to convey the idea that the buildings themselves are ruined or neglected; I allude to their emptiness, and to the absence of that state which once filled them with its splendour. To her honour, the hospitals of Italy have long been known for their number, extent, and order, and these are still models in many respects. Although not *many* works, yet some of great magnitude are going on in Italy, and in these taste in design, magnificence in material, and solidity of construction, are displayed. The restoration of the Basilica of St. Paul's at Rome is an immense undertaking: to effect it, contributions have been obtained from all countries, whether in money or materials. It is said that George the Fourth subscribed: and I may mention that the façade of another church in the Eternal City has been built at that sovereign's expense, in a way which he must little have anticipated. When the celebrated Gonsalvi visited England, his Majesty presented him with a magnificent snuff-box, which the cardinal in his will directed to be sold, and the proceeds applied to put a front on a church which had for a long time been unfinished in that respect.

The passion which all pontiffs have displayed for building still animates the less potent holders of St. Peter's chair of our day: and although inhabiting a palace which contains twenty-two court-yards, twelve halls of entrance, twenty-two grand stair-cases, and thirteen hundred of various descriptions; two large chapels, and eleven thousand rooms and galleries, in which miles may be walked without returning on the steps, yet each succeeding pope adds or alters, or marks repairs with his sculptured coat of arms.

Although there is not much employment for architects in Italy, there can be no question of the skill displayed in erecting their designs. The masonry is excellent, and the ancient Roman brick-work is rivalled by that of the present generation: houses are built of brick, in which all the exterior decorations are moulded in that material as perfectly as if executed in stone. The skill with which the Italian workmen build in brick may be exemplified by a notice of the Florentine practice of arching over rooms without centering of any description. Two thin moulds of board, the shape of the intended arch, alone are used; these are placed at each end of the apartment which it is intended to cover in, and pieces of string are stretched from the one to the other, guiding the workman as he advances in the formation of his arch, which he builds, uniting the bricks by their thin edges (greatly thinner than in those we use), and trusting entirely to the tenacity and quick setting of the cement.

Plastering is carried to a perfection in Italy of which we have, I believe, no idea in this country; rooms are so exquisitely finished, that no additional work in the shape of house-painting is required, the polish of the plaster and its evenness of tint rivalling fine porcelain. At times the surface of the plaster is fluted, or various designs are executed in *intaglio* upon it, in the most beautiful manner. Scagliola, a very fine preparation from gypsum, is the material chiefly used.

As an instance of the cheap rate at which this work is done, I may mention the new ball-room in the Palazzo Pitti, grand-ducal residence at Florence, which, including mouldings, figures, bas-reliefs, and ornaments, was executed at a cost of two crowns for every four feet square.

Work in scagliola naturally follows in my notice of the arts of architectural decoration; but this I need not decribe, as the art is now practised in England with great success, and an artist has lately settled in Edinburgh, whom I earnestly hope may meet with encouragement. A most beautiful art may be mentioned here in connection with the last, I mean that of making what are termed Venetian pavements which might advantageously be introduced into this country. The floors of rooms are finished with this pavement, as it is somewhat incongruously termed, and I shall briefly decribe the mode of operation in making these, but must first observe that they are usually formed over vaults. In the first place, a foundation is laid of lime mixed with *pozzolana* and small pieces of broken stone: this is in fact a sort of concrete, which must be well beaten and levelled. When this is perfectly dry, a fine paste, as it is termed by the Italians, must be made of lime, *pozzolana*, and sand: a yellow sand is used which tinges the mixture: this is carefully spread to a depth of one or two inches, according to circumstances. Over this is laid a layer of irregularly broken minute pieces of marble of different colours, and if it is wished, these can be arranged in patterns. After the paste is completely covered with pieces of marble, men proceed to beat the floor with large and heavy tools made for the purpose: when the whole has been beaten into a compact mass, the paste appearing above the pieces of marble, it is left to harden. It is then rubbed smooth with fine grained stones, and is finally brought to a high polish with emery powder, marble-dust, and, lastly, boiled oil rubbed on with flannel.

This makes a durable and very beautiful floor, which in this country would be well adapted for halls, conservatories, and other buildings. In connection with the arts which the architect summons to his aid, I shall now notice that of ornamental sculpture: and here again we must acknowledge the superior skill of the Italians. The chief encouragement to artists of this description, is that given by foreigners, especially by English travellers in Italy. Copies of ancient sculptures, vases, chimney-pieces, and other ornamental articles, are executed in the most perfect manner, and at a very cheap rate. Such is the skill of the Italian workmen, that a native of Carrara actually cut a bird-cage in marble, which he presented to his sovereign the Duke of Modena, who, by the return he made, rather showed his sense of the folly of the sculptor, than of his patient perseverance in the production of so useless a specimen of his skill.

But whilst the sculptor displays his skill in these comparatively trifling departments, he is equally successful in the execution of architectural details on the most gigantic scale, whether in solid marble or in veneer. By this latter art he produces magnificent columns plain and fluted, the core of which is of coarse stone, but the joining of the marble-coating is so perfect that the finished pillar seems a mass of solid marble. The marble is attached in a rough state to the core by means of a cement composed of resin and marble dust, which is so tenacious that it admits of the hammering, chiselling, and polishing necessary in finishing the work. By means of this system of veneering, the interior walls of churches and other buildings are encrusted with rich and varied marbles, and tables and other articles of furniture are manufactured at a very cheap rate. The art which I have just described is, in fact, that of pietra dura on a gigantic scale.

With the sculpture of the Italians in alabaster, you must be all acquainted. This art is chiefly practised at Pisa, Florence, and Leghorn. The material, besides being used in sculpture, is ingeniously applied in Rome to the manufacture of false pearls. The pieces of alabaster, after being turned and filed into the proper shape, are enveloped in a brilliant paste, made with the scales of a very small fish found near the shores of the Mediterranean.

To return to the subsidiary arts of architecture, I may remark that the carpentry of the Italians, as observable in ordinary houses, displays little skill and indifferent workmanship; but in the roofs and floors of important buildings, they satisfactorily prove their knowledge of scientific principles, and several of their designs are well known to British architects.

With regard to the working of iron, in comparison with our system the Italian is primitive indeed; yet at times they can and do produce very good specimens of workmanship, but at a heavy cost; consequently they are generally content with very ordinary productions. A manufactory of wire, and of driving and screw nails, by means of machinery, *now occupies the villa of Mecænas at Tivoli;* the articles produced are very well made. Copper is extensively used in Italy, and there are productive mines in the *Maremma Toscana*. The workmanship of articles made of this metal is respectable; various utensils are made of brass in a very neat and satisfactory manner, but in the interior finishing of houses, if much nicety is required, articles of foreign manufacture are used.

House-painters may be mentioned in the last place, and these display much taste and skill; and there is a class of them who greatly excel those in this country, having more the feeling and taste of artists. Surrounded by the finest models in this art, the Italian decorator enjoys every advantage in its study, and he inherits besides from the best periods of art, or rather from all antiquity, taste and a good system of workmanship. He is not a mere machine like the workman in this country, who has little use for an intellect beyond enabling him to use his moulds, stamps, and the various mechanical contrivances which confine all our decorative arts within such commonplace limits.

In all our architectural drawings and engravings, we find a vigorous artist-like style, which is reflected in the works done from them. In the architectural engravings of the present day, every thing is sacrificed to a display of dexterity in the use of the burin; the spirit of the original ornaments is never represented. How strongly this is illustrated, for example, in our engravings from Etruscan vases! Works executed from such engravings, or from drawings like them, are naturally stiff and lifeless like the models. People who possess a feeling of taste, dissatisfied with such productions, seek to replace them with older specimens, and amongst other things very inconvenient carved chairs and tables, in the workmanship of which they find a pleasure in tracing the influence of mind. But the cleverness in the workmanship of these specimens has greatly misled the taste of the day; and the abominations of Elizabethan architecture, lately dignified with the name of the *Renaissance* style, of which however it is a mere caricature, the extravagances of the Louis XIV. and XV. eras, or the debonnaire barbarisms of Watteau, have contributed to the banishment of a healthy taste in style. To restore a feeling for better art, the purer styles of classic or Gothic art must again be executed in the spirit of better times, and to grace of form must be added feeling in execution.

I shall now turn to the engineering works of Italy, a subject worthy of much attention, but on which I regret to say I am able to say very little indeed. The greatest works I saw going on were those at Tivoli, and from the Ombrone to the Lake of Castiglione in the Tuscan Maremma. I shall merely offer a very brief description of these works, necessarily very imperfect, as I write entirely from memory. The Tiber or Aniene, on reaching Tivoli, was dammed up by the architect Bernini: precipitating itself over the lofty barrier he raised, it disappeared under the rocks on which the town is built, and was seen again in the celebrated grotto of Neptune; rushing out of this remarkable cavern it fell into another abyss, and again vanished into the grotto of the Sirens, from whence it issued in the deep valley under Tivoli, several hundred feet below its original level. The pencils of the painters of every nation have been employed for centuries with this,

Fig. 1.

A, Great Fall. B, Neptune's Grotto. C, Fall. D, Fall. E, Grotto of Sirens. F, F, New Tunnels. H, New Fall. I, Road to Villa of Mecena.

I may say, terrible scenery, this *orrido bello*, of the falls of Tivoli. They may now depict the rocks, but the waters are gone for ever. Some years ago, Bernini's dam was carried away in a flood: it was rebuilt by the Pope's engineers, but if I remember aright the river got the better of them and threw down their work; at last they dammed up old Tiber, and made the very ugliest waterfall that ever unfortunate artist contemplated. It was now discovered that the river, in passing through Neptune's grotto, had worn away the rocks in such a manner that the town and its temple depended on a rugged pillar, the duration of which could not be calculated upon. To prevent the town paying a visit to the Sirens beneath, it was resolved to turn the river, and it will be acknowledged that this was a bold undertaking; walled in by mountains, it sought a passage under them: and to a certain extent imitating the operations of nature, the engineers have carried the river through two parallel tunnels, and tumbled it into the valley beyond the Sirens' grotto over a bank twice or perhaps three times as high as the Caston hill. The engineers have saved Tivoli, but its romantic beauty, as far as the river is concerned, is gone for ever.

The other engineering work which I mentioned, namely, the canal from the Ombrone to the Lake of Castiglione, has excited much interest. The Lake of Castiglione, anciently the Lacus Prilis, falling very low in summer, left much marshy ground uncovered, in which were numerous stagnant pools, and quantities of putrid herbage, making the air poisonous in hot weather, and breeding myriads of noxious insects. To remedy these evils, Leopold the First ordered his architect Ximenes to make a canal from the river Ombrone to the lake: by this means it was intended to keep the latter constantly at the same level. This work was finally executed by the present Grand Duke in the year 1830, and by means of a canal seven miles long and twenty-five feet broad, a sufficiency of water is supplied to keep the lake at a proper level; so sufficient indeed was the supply that the whole surrounding country was overflowed the first year, but this has been remedied. The air it is said has been improved; but when I visited Castiglione in 1832, I found that all who could left it in the summer months, and all who remained had the fever. Some notice may be expected from me of the engineering works in the Pontine marshes; but like other British travellers, I have only galloped through them, and have merely to state that the attempts to drain them cost a million of money.

The roads in the north of Italy are excellent, and indeed generally throughout the Peninsula; although a small portion comparatively of the country is intersected by roads; and I have travelled many miles over turf, or by small mule tracks, both on the coast and in the mountains. Towns are almost universally built on eminences; consequently the roads are hilly, but I think less so than would be supposed from the nature of the country, and both in direction and in smoothness, they greatly excel those of France.

The system of road-making followed is nearly the same as that adopted by the late Mr. Telford, that is to say, a pavement of stones is first formed upon which the metal is laid; but I do not think that the principles advocated by our great engineer are followed out in the formation of the pavement. Excellent roads, however, are the result of the system, even although gravel is used instead of broken metal.*

Various principles of paving are now exciting much attention in London; it is to be regretted that something like a sensible principle is not followed in Edinburgh. In Italy various mode are adopted, in Genoa and at Naples large flat parallelograms of lava are used, at Florence large irregular polygons carefully jointed, and at Rome a pavement resembling our own, except that the stones are of irregular forms, of one size, and grouted in with lime and *pozzolana*.

I shall now touch very briefly on a few arts of Italy which remain to be described, and shall then take the liberty of bringing before you one or two contrivances which struck me as ingenious and of which I have prepared drawings.

The goldsmiths of Italy produce ornaments which are both remarkable for taste and workmanship, especially those of Genoa and Venice. I am enabled to show you some trifling specimens which our workmen cannot equal.

After the goldsmiths I may mention the makers of bronze ornaments and figures; this is an art in which the Italians show much taste and dexterity, so much dexterity indeed that they sell numbers of antique

* I have not seen the railroad which has been lately made from Naples to Castellamare, but am well acquainted with the line; a novel question in engineering must arise in considering how it is to be protected from the lava of Vesuvius. This I believe will not be very difficult, but it has a more insidious enemy in the earthquake, and a more overwhelming one in the showers of scoriæ and ashes which accompany an eruption.

Railways may be useful in Italy to promote her commercial prosperity, but I pity the man who could think of travelling in such a manner through any part of that country.

bronzes of modern fabric yearly to *soi-disant* antiquaries, who, however, neither possess that extensive learning nor profound experience and correct taste necessary to constitute such a character. It is much the practice in Rome to take moulds from real lizards and to cast them in bronze; these make very pretty ornaments for the table. I regret that I am unable to give you an idea of the value set upon these works.

The manufacture of glass is pursued with great success in Venice: the numerous glass ornaments for ladies which come thence are well known, and the endless varieties of form and combinations of colour given to glass beads for rosaries and embroidery, or vessels for domestic use, are very ingenious and beautiful. The ruby glass of the 1500 and 1600 can now be imitated so as to make imposition a famous trade, the false being only distinguishable by weight. Glasses are also made in which white threadlike lines of arsenic are incorporated. The process by which they make sheet-glass differs from ours. Instead of being formed into immense circular sheets, the Venetian workman blows cylinders of considerable length and diameter; he then cuts off the two ends of his cylinder, dexterously slits it down one side, and spreads it flat on a table in an oven. By this process sheets of a sufficient size are made, and there is no loss as in those fabricated in this country.

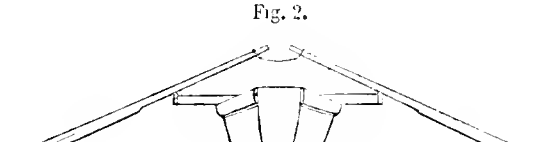
I think that I have lately observed that the process which I have thus briefly described is practised at some manufactory in England.

The velvets of Genoa, and the exquisitely turned ware of the same place, the straw hats of Tuscany, the silks of Florence, the embroideries of Rome, the musical instruments and musical strings, and although last not least, the maccaroni, of Naples, are all samples of skill creditable to the Italians.

I shall now request your attention to this lithograph of a triumphal arch. This is a specimen of an art in which the Italians display both taste and great ingenuity, and which seems to me deserving of notice, for although it may be deemed useless by some, yet it contributes largely to their happiness. I allude to their preparations for festivals and pageants. Without entering into any description of these, I shall content myself with exhibiting a print of a triumphal arch erected at Tivoli on the occasion of a visit from his Holiness the Pope. Erections of this description are put up in a day or two, being formed of a frame work of wood, covered with coarse canvass painted in imitation of stone. The bas-reliefs are of stucco, and the statues are formed of straw, arranged round wooden supports; casts of heads, hands, and feet are easily procured and attached. This *anima* (soul), as it is termed, is skilfully enveloped in drapery of cotton cloth, which is tastefully arranged by an artist, ond is then lightly brushed over with white-wash, which stiffens it. That a knowledge of the art displayed in erecting this arch may be useful, may I think be proved, by an allusion to the gallows-like erection under which his Majesty George IV. passed when he entered Ediuburgh.

In the summer of 1833 I made a journey from Leghorn to Rome along the coast, a *terra incognita* to most travellers, my object being to trace the Via Aurelia. At Orbetello, the last town in the Tuscan States, besides making some interesting antiquarian discoveries, I observed the boats which I am about to describe. Orbetello stands upon a peninsula, projecting into a shalluw lagoon of some extent; the boats which are used upon it, are flat-bottomed, rise considerably at the bow and stern, being lowest at midships, across which part of the vessel a beam is fastened, about four inches thick each way, and which projects about two feet six inches over each side. On each of the ends of this beam an oblong piece of plank is nailed, the longest sides being horizontal, and a stout pin rises from each of these. The oars are of considerable length in proportion of the boat, and of great breadth in the blade. The oars rest upon the pieces of board at the ends of the cross-beam, being attached to the pin by means of a piece of cord, in this last respect resembling a mode adopted in boats on our own coasts. The blade of the oar slightly overbalances the portion within the fulcrum on which it rests, the handles nearly touch each other, meeting a-midship. By this contrivance, one man can manage a pair of very powerful oars, and can drive a boat, which is apparently but ill adapted from its form for speed, with surprising rapidity through the water; can arrest its progress, or turn it with equal rapidity and certainty, and with very little exertion. The annexed engraving is a transverse view of one of the boats.

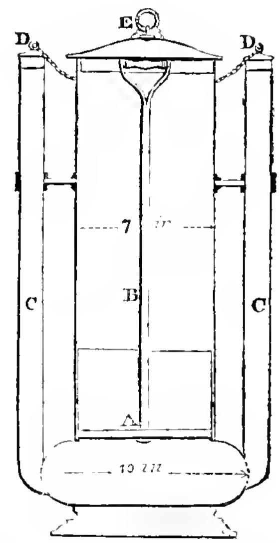
Fig. 2.



My knowledge of boats and ships is indeed very trifling, but I could not help seeing how easily the fisher of Orbetello manœuvred his rude boat; and therefore I have been induced to bring forward this notice of a vessel and mode of rowing which I am not aware has been described. Besides, it suggests ideas as to the probable mode in which the ancients managed their triremes, well worthy the attention of the antiquary, especially if he will combine the hint thus obtained with the modes of rowing followed in the Bay of Naples on board the Sorrentine boats, which, I have been led to imagine from an examination of pictures in Pompeii, are much the same in every respect as the galleys which in old times navigated the same sea.

My next drawing represents (fig. 3), by means of a section, an apparatus used in Italy for warming baths. I need not describe it, but shall merely observe generally, that it is made of copper; the live charcoal is put upon the grating A, which is put into the stove by means of the handle B, the fire is kept alive by air supplied through the tubes C C, 7 inches diameter, and when immersed in the water of a slipper-bath, this light and portable apparatus will heat it in a quarter of an hour. I think it might be useful in this country.

Fig. 3.



I now close this paper with many apologies for having detained you so long. The engineering works I have briefly described may seem trifling as compared with those extraordinary and gigantic operations you are accustomed to in this country; but I would ask you to consider the relative extent, power, and resources of the states, and you must then allow that they are very creditable to the Italian Government.

The Italians, we have seen, are still remarkable for their taste and skill in many beautiful arts, and for nearly 3000 years they have been thus distinguished. Various arts were successfully practised by the Etruscans, and when they were subdued by the ruder Romans, they did not lose their skill, but enlightened their masters.

The conquest of Greece filled Italy with artists and works of art; and when northern hordes overwhelmed the empire, these ruthless barbarians were gradually softened by the fine arts of the people they had conquered. A new power arose in Italy, and by its influence again she became pre-eminent in Europe, and we know to what illustrious perfection the fine arts again attained.

In our sale-rooms we see sold every winter many cracked and dingy daubs, and with these before him, the auctioneer rings the changes on some half-dozen names, as if the Italian school could boast no more: but a host of artists attest the fertility of Italy in the production of men of talent; and in Lanzi's dictionary, 1000 names will be found before the reader reaches the middle of the letter D in the index.

I have imperfectly described to you some of the arts which the Italian has inherited. I shall close this paper by observing that, whatever public work is undertaken in Italy—wherever improvement is contemplated, even although it should not be extensive, it is justly thought that the assistance and advice of the artist, whose taste and judgment have been cultivated, ought to be secured, and there is no practice in *its full extent* more worthy of our imitation.*

* Mr. Wilson exhibited numerous specimens of mosaic, pietra dura, cameos of different ages in pietra dura, and specimens of shell cameos; also of Genoese and Venetian jewellery, Venetian glass, and ruby glass, together with numerous prints and drawings.

ON THE STYLE OF BURLINGTON AS COMPARED WITH THAT OF PALLADIO.

Architecture and its relics betray the character of a people: an evidence in themselves of national credit or misrule, they shed a pleasing truth upon the record of history: for there is a link between the feudal castle and vassallage, between the stately palace and increasing revenue or commerce, between the more modest villa and a privileged community. Carrying our minds, then, with this pleasing idea, from the castle and the monastery, down to the 17th century, when Gothic began to yield to the influences of Italian art, we observe one architect whose talents, united to rank, justly merit our notice. Comparing him with his great master, we may, perhaps, lessen his claim to originality; but as a disciple of Palladio, he will ever appear, for the age in which he lived, an architect of refined taste and of elegant mind.

Burlington, aiming after Palladio and yet captivated by Jones, stands distinguished from both, mingling, as he does, a little from the richness of the latter, with the more grave simplicity of the former. Tamer in his conceptions, the elevation displays nothing of that intricacy of parts, or of changing features, resolved and blended into one harmonious whole as in Jones:—his unity is the whole, whilst his parts are fewer. No studied appropriation of ornament compels the eye to any particular part, no lofty feature rises to dignity. The feeling of the artist is never led astray into any redundancy—all is depressed, though carefully disposed. It cannot be said that he is grand, for that excellence is destroyed by uniformity; nor can it be said that he is mean, for his variety, though scanty, is made up of parts as much as of detail. He has his partialities, however, and loves the colonnade, through the openings of which he permits you to see his statues. Of statues, however, as of columns, he is very sparing, and seldom exhibits the former prominently except on the second story. Sufficiently alive to the sentiment of Palladio, he never wearies but always carries you pleased to the wings of the façade:—but, with here and there the introduction of a balustrade, the relief of a figure, or a special window at the wings, he is content. As an architect we must admire him more for his care than for his ingenuity, more for his adherence to the existing rules of harmony, than for that poetic sentiment, that brilliancy of idea, ever indulging though ever beautiful, displaying features ever new and yet ever subordinate.

Turning now to the Italian, let us mark his excellencies, which (being imitated by Burlington), when seen, will show how far he identified himself with the genius of his master. To say nothing of the talent which could change the features of his country's art, by investing it with charms both new and various, we might regard him merely as the vigorous restorer of ancient beauty. But, uniting the most suspicious care with the deepest enthusiasm, this master of combinations, this genius of distribution, swelled the proportions and increased the grandeur of design by a system original and true. Friendly to the pedant whilst studying at Rome, but superior to the pedant in his conceits and imaginings, Palladio allowed the same principles of rigid adjustment that guided the ancient in his proportions to assist him in his. But the contrast appears in the increased and enlarged conceptions of the latter as compared with the condensed beauties of the former, different to Burlington who seldom starts into any thing grand, or deals in gradations of feature. If the ancient has unity, expression or variety, so has Palladio. If the one has a subordination of parts so has the other:—the difference is in the extent. That correct sentiment which assisted the depressed model of antiquity, aided the giant structure of the middle ages, whilst a harmony of relation belongs to the mansions of Palladio, no less than to the temples of Rome. Burlington appears but faintly to realize these ideas of relative beauty, there is no grand feature to which others are subsidiary. In Palladio's front the giant superficies displays degrees of importance amidst its many subservient members; and it is not until the more considerable images have been scanned, that the lesser contrivances are seen. The resemblance in style between Burlington and Palladio is in the smaller auxiliaries only, where the variety is uniform, like rhymes in poetry, alternately, and where variety has its variety, "like the stanza."

It must be remembered, in conclusion, that Burlington had to follow the Italian at a great distance, and to digest a new style at a time when refinement and conceptions of the beautiful faintly existed. Remembering this, whilst looking at the monuments of taste he has left us, we see his ready talent, and that pleasing display of native genius, wanting only a closer study from the same models, and the same attention to the true elements of grandeur to have rivalled, if not to have surpassed him.

FREDERICK EAST.

January, 1841.

REPLY TO EDER'S REMARKS ON THE ARCHITECTURE OF LIVERPOOL.

SIR.—Seeing that the remarks of "Eder," on the Architecture of Liverpool have obtained a place in your Journal, and consequently an importance which they had not when they first appeared in a paper of this town, I will, with your permission, examine them a little.

I will agree with "Eder" that the Railway Station is a great failure, but I should much like to learn from him how a front should be designed, "which by its outward appearance should tell of the great things going on behind it."

It is amusing to observe writers like "Eder" laying down dogmas such as "Every edifice should express its object. A church should display gravity and dignity, a theatre lightness and gaiety, a prison rude majesty and sturdy strength, in short every edifice should like the countenance express spirit." "In short," comes in here very well, for the writer could not furnish another illustration. What should a Bank display? a Custom House? a Market? But "Eder" has solved the latter query by telling us that the Fish Hall "presents a very quiet plain portico expressive of its object;" so then on seeing "*a very quiet plain portico*," we may rest assured of its being the entrance of a fish market! A few axioms of this kind would render guides and guide-posts unnecessary. Unfortunately, however, the proprietors do not seem to consider the portico "expressive of its object," for they have caused the words "Fish Hall" to be painted in large letters on the architrave. So great is my dullness that I never yet saw a portico which expressed its object, unless that was to keep off the rain and sun.

Eder calls the "North and South Wales Bank one of the handsomest in town," it is true that the ground is "irregular in shape," the front being a little more than a right angle, so little however as not to be worth mentioning: it is also true that the architect has been "compelled to obtain in height what he wanted in superficies, and yet here are *enormous* difficulties overcome, and a handsome building in conclusion remains." The "*enormous difficulty*" consisted in building a bank three stories in height. Now for its beauty. The front consists of a Corinthian portico *in antis*, being about three times its width in height, the columns and pilasters are crowded together, between the columns there are a door, and two tiers of windows scarcely large enough for a third rate house: the front is made about one foot narrower than was necessary to obtain less projection in the cornice of one flank, so that by this happy idea you have this foot in width sticking on what ought to have been the return of the pilaster, and decorated with the rustic work, belts, &c. of the flank, which have no connection with the front. This I confess is a "handsome" way of getting over the "enormous" difficulty of reducing the projection of the cornice. The flank which is exposed to view is a strange jumble of pilasters, paltry doors and windows of all sorts and sizes, some Greek, some circular headed, some with swelled friezes—scarcely a foot of plain masonry is to be seen here. The architect has rigidly copied the columns and entablature from an ancient example, but he has misapplied and misarranged them, and the order which charms by its lightness and grace, the spectator in the Campo Vaccino, seems here clumsy and heavy, and the substructure does not seem half strong enough to carry the entablature. The ornamental parts of the order are passably executed; all the others both in design and execution (no man *could* make those things on the principal door architrave ornamental), are most wretched. To conclude, this building has cost an enormous sum. I shall probably return to this subject, meanwhile

I remain, your's, &c.

SEYTON.

Liverpool, January 19, 1841.

Ancient Trees of the Spanish Chestnut.—Although certainly not a native of this country, England produces some exceedingly remarkable specimens of this valuable tree. In Betchwork Park, near Dorking, there are some Spanish chestnut trees of extraordinary size and great age, certainly the largest and oldest in that part of the country. There are about 80 trees, all of large dimensions. The subjoined table exhibits the circumference of some of the largest, taken about three feet from the ground:—

No. 1	17	2	No. 8	18	0
2	20	6	9	21	4
3	17	10	10	18	4
4	17	0	11	19	3
5	17	2	12	20	2
6	18	0	13	18	0
7	19	2	14	23	0

No certain record, I believe, exists of the age of these trees, but they are probably coeval with the first Betchworth Castle, founded in 1377, when "John Fitzalan, second son of Richard, Earl of Arundel, had license to embattle his manor-house here."—*Gardeners' Chronicle.*

UPON THE ARCHITECTURE OF ITALY.

A Translation of the Observations contained in the Preface to M. Percier's work, entitled "Palais et Maisons de Rome;" with some Additional Remarks upon that Preface.

By Arthur Wm. Hakewill.

The object of the following observations from the pen of M. Piercer was to induce his countrymen to bestow pains upon the smallest, as well as upon the most important works, and to anybody conversant with the French modern architecture, it must appear that the architectural productions and writings of that great architect have had their effect, France now being enlivened and beautified by numerous works upon a small scale, carefully and picturesquely designed. M. Percier was the very man to propagate principles with success; to great talent he united great amiability, and the precepts which he taught made a lasting impression, for they found their way to the minds of his pupils through their hearts, of which he had entire possession. He is now lost to France, to which country he has bequeathed a rich legacy, in the numerous skilful architectural productions and sage precepts which he has left, and the name of Percier will be long cherished, not only by a grateful country, but by all those who are sincerely devoted to the art in which he who possessed that name so greatly excelled.

It being constantly a subject of remark, that works upon a small scale in this country do not receive all that care and study so necessary to give them their full effect, it would appear that the observations alluded to might be as beneficially applied to England in the present day as they were to France formerly.

The English architect seems to think that great works alone require great exertion; it must be confessed that on such occasions he seldom fails to rise to a level with his subject, and Ste. Genevieve at Paris, compared with St. Paul's in London, either in *design* or construction, appears a toy. But it is not an occasional building of this kind that shows a nation fond of architecture, or which tends greatly to the decoration of a country; these two ends can only be compassed by the architect fairly appreciating the scope of his art, by considering it as an artificial landscape which mankind create to themselves; and therefore endeavouring to bestow on each production, however insignificant in size, all that study, care, and attention, of which the subject is susceptible, in order to produce a legitimate variety in his compositions, and to impart to each work a *correct* and *peculiar* character.

M. Percier says—

"Architects, upon their arrival at Rome, for the purpose of studying their art, will naturally bestow their first attention upon the valuable remains of antiquity, upon those imposing masses which, having resisted the ravages of time and barbarism, announce to posterity the grandeur and power of the Romans.

"After this first view, their admiration will be divided between such beautiful monuments and those which either the piety of the Popes, or the magnificence of the Roman princes, gave rise to in the fifteenth century, at the revival of the arts.

"Drawing and engraving, by multiplying the master-pieces of ancient architecture, have, as it were, laid Rome before the eyes of all; from the study of these buildings, some men of genius were enabled to deduce the elementary principles of architecture, they have taught us how to view these buildings and contrast them, whilst, by their own example, they have shown us how very possible it was to make a successful application of those fine models, upon occasions which might seem to offer but little scope for creating interest.

"This observation has, for a long time, escaped the attention of architects visiting Italy: it was thought that the studies to be made in that beautiful land, could only benefit artists who had great buildings to construct, whilst every thing which did not carry with it a certain degree of importance, was to be abandoned to the routine and caprice of workmen.

"But there are in Italy, and particularly in Rome, a vast number of charming habitations, which, under the most simple forms, bear the stamp of a refined taste, and prove to the attentive architect, that credit may be obtained in bestowing care upon the most humble production, and this reflection should be a consolation to those who profess an art, in which a very rare combination of fortunate circumstances can alone furnish the opportunity of being entrusted with the execution of great works.

"If such men as Bramante, Vignola, Palladio, Sangallo, and Peruzzi, have discovered in antiquity models for the buildings which they have erected, if these successful practitioners of the art have known how to apply, even in their slightest works, such admirable distribution, so agreeable an arrangement of parts, that refinement, *too*, which constitutes the great charm of their works, why should *we* not, when similarly circumstanced, endeavour to emulate them?

"It is with the liveliest feelings of interest that we behold the great artists whom we have just mentioned, bestowing, upon the simple habitation of the citizen, the same degree of spirit, care, and refinement of taste, which they have manifested in the erection of temples and sumptuous edifices. They have embellished every thing, and their pencils have thrown a charm over the modest retreat of the philosopher, in no way inferior to that of the palace of the prince.

"Penetrated with the importance of their art, they have taught us how to rid it of the prejudices of routine and the extravagancies of caprice, they have taught us to take nature for our guide, and her imitators for our models; and have, in some measure, restored architecture, in bringing back the art to its true intent. We ever perceive them skilfully availing themselves of the peculiarities of the site, and fulfilling, with admirable address, the various requisites of the design. Manifesting ingenuity even in the minutest detail, they never appear to have worked at random; they seem to have felt that nothing could be considered beautiful in architecture which was not authorized by some recognized utility; that true genius did not consist, as some moderns have thought, in waging war with reason to create novelties, and produce bizarre effects, but rather in the art of successfully applying the means which nature points out, which the site furnishes, and which the work in hand demands.

"It is in thus fulfilling these conditions that they have succeeded in imparting to each work its proper character, and it is thus that, ever guided by good taste, they have been enabled to make us lose sight even of the very difficulties they had to combat.

"Indeed, the greater part of their works bear the impress of that rare simplicity which, like some revealed truth, always appears so intelligible to those to whom it is disclosed.

"Their buildings are picturesque without being confused, possess symmetry but are not monotonous, and being carefully executed, frequently unite, to express ourselves in terms of art, the freedom of the sketch with the precision of the more finished performance.

"We contemplate, with unceasing admiration, the ingenuity displayed in the application of the various materials, such as marble, stone, brick, wood, &c., few examples of which are to be found elsewhere.

"It must be confessed that hitherto the Italian architects have excelled those of other nations. To produce the greatest effect with the most simple means, seems to have been the object of their ambition; whereas we, on the contrary, seem to take an opposite aim. It would appear, by the greater part of our modern works, our apartments ingeniously circumscribed, our petty distributions, our plaster columns, bronzed wood, and painted marbles, that we delighted in imitation, contenting ourselves with appearances.

"We will not seek to unveil the real causes of this degradation of the art, we cannot think that it has been brought about through motives of economy; for it would not be difficult to prove that such imitations, far from being less costly, entail, on the contrary, continual expences, both from the short time they last, as from the enormous prices set upon such works by skilful workmen.

"We might, perhaps, with regret, pronounce it to be a proof that architecture has never been held in great estimation among us; for the circumstance of a town containing a temple, a monument, a palace, is no argument that the fine arts have made it their abode; the tyranny, pride, or caprice of a single individual, may, for the moment, have chained them to the spot. But when, at every step, our attention is arrested by some masterpiece of magnificence, or even of simplicity: when in every spot we meet with monuments erected for the public good, the minutest detail characterized by that delicacy of taste which proclaims a whole nation to have been cultivators of the fine arts; then it is that we feel we are in Italy, and that that gifted land has long been their fixed abode.

"It is in that country alone that the most humble habitation offers to the attentive architect beauties, not very imposing, perhaps, in point of scale, but more immediately adapted to the wants of the community. It is to be observed that the charm of these buildings results from the arrangement of the plan and distribution of the masses, and not to a vain profusion of ornament.

"We do not pretend to say that the buildings which we have cited should be servilely copied, nor do we quote them as being entirely free from defects; we are also aware that our climate, materials, and habits, often prescribe other forms. But still we may safely assert, that by following the method which the Italian architects have pursued in their compositions, in considering them relatively to the conditions they had to fulfil; in short, *by studying them*, an attentive architect will know how to reap advantage from the light which they throw upon his art."

Thus far our author.

In the course of these observations there is one which it may be allowable to remark upon, viz., the conviction that comes over the mind of the traveller in Italy, that that favoured land has once been the fixed abode of architecture. In her flight from Greece to Italy, architecture alighted upon a congenial soil, and flourished through the land, owing to the solicitude of the inhabitants in courting her stay among them. The Italians soon found that architecture was their domain, and set about studying it in that vigorous manner in which a nation endeavours to effect any object influencing its honour; the chief requisites for an architect being ascertained, they were early inculcated, and geometry and drawing were made the basis of excellence; indeed, most of the Italian architects drew like painters; all dwell upon the importance of that art in their writings, and manifest it by the *rigour, delicacy*, and *choice of detail*, in their buildings; and one of them, Scamozzi, treats of it in terms of veneration, and says "that since, by means of drawing, that is so easily expressed which cannot be described, even by a multiplicity of words, we may rightly say that this art should be rather considered as a heavenly gift than as a mere discovery of human invention"—in the original thus:

"Di modo che, per via del disegno, si esprime molto facilmente tutto quello, che non può far la moltiplicità delle parole expresse, o descritte in carta, e per ciò, a ragione si può dire, che il disegno sia piu tosto dono celeste di Dio, che cosa ritrovata dall'ingegno humano"—

We may clearly see that it was not because architecture was practised by Italians, that the art made steady progress towards perfection, but because the Italians, appreciating the art, studied it in a legitimate manner, resting their claims upon the intrinsic merits of their compositions, and having no recourse to the blandishments of art, either to make a parade of their beauties, or to screen their defects; hence it was that buildings, promising comparatively but little upon paper, when erected became a real embellishment, creating delight and surprise, answering completely the description of a French writer, who says that a building should suit as a model to an architect, as a subject for the painter, and as an object of attraction to the general observer.

A very little reflection will make us feel that the course we pursue is very different from that pursued by the Italians of the fifteenth century, and those who once shed a lustre upon this nation during its great periods of art.

It is ever essential that the means taken should be commensurate with the end proposed; and as the end here is great, the means should be so too. Architecture is a severe art, and consequently should be severely studied. *Geometry*, the *orders*, the human form, foliage, the countless and various objects of nature, are fit subjects for the serious attention of the student of so delightful, comprehensive, and sublime an art as that of architecture. Doubtlessly, there are many accomplishments which, if not pursued to the detriment of more solid acquirements, add greatly to the perfection of the architect. But may it not be asked whether we of the present day pay not too much attention to these accomplishments, viewing them rather as the fit materials for the foundation of our studies, than as what they should be considered, the accessorial embellishments of the uperstructure.

Foremost, then, among these accomplishments, is that of water colour painting, which, from the developement given to it of late, appears amongst us a new art; there can be no doubt that, in the hands of a judicious architect, this art may prove a valuable acquisition; but indiscriminately pursued and applied, as it frequently is with us, as a substitute for accuracy of form in drawing, it may act as a serious check to the progress of architecture. It has this pernicious quality, it easily captivates the mind of the student, and early destroys that relish for those more severe studies which are so necessary to his future excellence. Through the means of water colour painting, defects in architectural composition are frequently cloaked, which, when the building is in progress, appear in all their nakedness, to the mortification and *surprise* of the employers, and to the lasting discomfiture of the architect; and doubtlessly the forced and conventional style of setting off perspective views has led to the complaint so often heard in this day, that buildings, at their completion, fail to produce the effect they had in drawing, in short, that the drawing was a deception; we may feel assured that so fallacious a system is wholly incompatible with the attainment of excellence in so severe an art as that of architecture, and that if we wish to leave behind us buildings which shall strike posterity, as those buildings which the Italians have left do us, we must be content to submit ourselves to the same sage and sober method of studying which those great masters pursued, and then we shall enter the field with an advantage in our favour; for be it remembered, that the Italian architects were obliged to glean, from the works of their Roman ancestors, all they knew of Greek architecture; whereas, to us is disclosed the *mine* of Greek art itself, enabling us to go at once to the fountain head of taste, and of obeying, to the very letter, the advice which the Roman poet gave to his countrymen, when he told them to study the works of the Greeks by day and by night:—

" ———— vos exemplaria Græca
Nocturna versate manu, versate diurna."—Hor.

ON THE STANDARD OF ARCHITECTURAL BEAUTY AND SYMMETRICAL FORM.

By John Rooke, Esq., *Author of "Geology as a Science.*

In what may be called our own day, architectural forms that avowedly go by the name of taste, would seem to have fallen into all but ideal conceptions. A train of discussion has however been introduced into the Architect's Journal, based on the pure freedom of criticism, which is likely to uproot the inveterate conceits of the past ere long. Heaven's laws are all founded on omniscience, directed by the infinite wisdom of Almighty power. Were the universe divested of symmetrical proportions, by which each part sustains its duties in an infinite system, or bereft of the divine will, Chaos would necessarily lay prostrate the harmony of the heavens. But this is not so. God rules. Mind is more mighty than passive substance. Physics place the signet of universal truth on this comprehensive law, so conspicuously shown in all that comes within our means of observation. Mind has rendered all substance a self-acting instrument *on substance* by the adoption of such unification of purpose. We must believe in this ere we shall be able to take in science a single step, which is not empirical. All magnitudes of substance, which the intelligence of man is able to convert into substantial forms, and in which that substance operates upon itself, speedily fix their own limits, and would therefore break down under the influence of excessive weight. In the hands of heaven's laws, the extent of symmetrical harmonies is illimitable in magnitudes and exactness of proportions, in perfect conformity to a unity in design, worked by physics, as created by a Godhead, whose Almighty dominion nothing is either too extensive nor too small.

We may put our definitions on extent, and call this science, yet it is nothing beyond an amusing bubble, until we apply such definitions to the investigation of physical extent and combination in active forces. By such means we discover the universal and varied forms in which physics exist, and learn our own ignorance in the perfections and exactness of natural laws, even in the most trivial details, worked to their distinct ends, by that all-seeing mind which has made itself known through the medium of organic substance, working itself into like ends and means that are employed by man, when he embodies his conceptions and will in works of stone, wood, iron, or other materials, causing them to assume a self-working form for some end desired.

We so far observe two classes existing in forms of art. Those of heaven; and those of lowly man. In the first class, the more we study them, the more we find the adaptation of their provisions suited to their several uses. We find both a due quantity and quality of the materials employed to produce the ends required, neither more nor less, and taking the precise form held in view for attaining the object designed. This principle is constant in each and all of the works of the Deity, however opposite may be the magnitudes of such organic framework. The spheres of the heavens are so exactly adjusted in magnitudes as to retain their places truly; and work out those comprehensive changes in the phenomena of our earth which geology, as a science, based on the unity of divine wisdom, so plainly figures out to us. Though the earth may fly in its orbit at the rate of 68,000 miles in each hour, and turn on its axis more than 1000 an hour, yet these mighty motions, otherwise certain to disturb the waters of the earth, and cause them to roll over the most lofty eminences, have been effectually bridled by a depository process, which has made a fruitful land, symmetrical in surface lineaments, to appear from beneath those proud waves which have been thus stayed. By the same lofty destinies, and by the application of similar laws, every secure haven for ships, found on the borders of the great deeps, has its origin. We find the sturdy oak provided with sufficient strength of timber, and durability of quality to withstand the blasts of almost ten centuries. In that slim animal the hare we find material enough to impart to her the strength requisite for speed, without any of that unnecessary lumber, which would retard her foot, and operate as a drag upon her course. The greyhound may excel her in stride, and be able speedily to overtake her; yet her adaptation for turning more readily than her pursuer, chiefly owing perhaps to her more supple joints and less bulk, is suited for preservation. The ox, the horse ,the elephant, and indeed all other animals, are framed on symmetrical and mathematical rules which serve their wants and contribute to their preservation. So that we detect a unity prevailing throughout, which we must accept as constituting the only symmetry, harmony, or beauty which can exist—because the best uses are always made of any sum of materials in hand. All this exhibits the means by which in every instance conception and will gain an ascendancy over passive material bodies, and impart to them unity in beauty and adaptation to their uses. Symmetrical correspondences, which all admit to be a rule of beauty when truly adapted to their several purposes, form by no means an ideal taste, but a geometrical and mathematical rule rigidly observed in every instance. Who would recommend the drawing of circles and squares by taste? Nobody. Even a school-boy with his compasses and rules of art by which such figures are formed, would far outstrip in exactness of outline, the most accomplished artist that ever lived, had he no help except mere taste.

Coupling these observations with what has been given by the correspondents of the Architect's Journal, on the geometrical and mathematical harmonies of Gothic Architecture, it is plain that a fresh spirit in architectural design has been evoked. We claim for our day the age of science and civilization, and yet on what evidences does the claim depend? Do we prove our assumptions by a belief in the universal harmony of physics, springing from the causation of Almighty wisdom; or by the self-sufficiency of an empiricism, which utterly denies all connexion between philosophy and the laws of heaven? Why is it not obvious that we have a philosophy distinct from every religious consideration; and religious impressions which disclaim all evidences from philosophy; evils obviously existing because violent and bewildered extremes can neither agree with true science, nor with the purity of religion and morals. Mind is a universal power, of the mysteries of which we know nothing, except that it always works in pure physic according to geometrical and mathematical forms, upon the nearness of which to our frail bodies or distance from them we are totally unable to speculate.

Let this be accepted as the religious and philosophic belief of the English monks in the thirteenth century, as shown by the symmetrical harmony of their ecclesiastical edifices, and our ignorance and vanity are at once apparent. Yet no sooner do we observe scepticism, religious indifference, or bigotry creep into the public mind, than we find a decay in Gothic Architecture first appearing; and in less than two centuries it may be said to have been wholly lost, insomuch as the uniformity of geometric and mathematical rules were concerned. The purity of Gothic Architecture, (what a contemptuous name!) obviously sprang from the religious purity of the English monks in the thirteenth century, believing, as they must have done, that Almighty volition is manifested in the exactness of physics, geometrically and mathematically balanced in every work of the divine will. If we collect our proofs of this, from the day of Bede, in the eighth century, to that of Roger Bacon, in the thirteenth century, we shall discover one of the chief means, by which, in these five Gothic centuries, as we vainly call them, architecture and science had risen to a state of pre-eminence, which ought to make us blush for our own day, and acknowledge what lessons of wisdom we yet owe to the works of the Gothic barbarity bequeathed to us. Most unfortunately, according as papal bigotry and superstition vitiated the religious purity of every succeeding day, an opposite error crept in; and the world became all but divided between a superstitious despotism, which denied all reason in philosophy, and either a scepticism or a religious indifference, which promulgated a philosophy, independent of every religious consideration. In three centuries the lamp of genius, so brilliantly lit up at the fountain of heaven's laws, as evinced in the geometrical and mathematical exactness of Gothic Architecture, went out, and gave place to a race of imperfect copyists.* There can be no beauty but that which is symmetrically and mathematically adopted to the uses and ends held in view. Decoration, on all the rigidity of these severe rules, is displayed in every surface lineament of our globe; it is a scene of uses and beauties combined by the modus operandi of attributes divine. Ignorance may either overlook or deny this; and scepticism in the weight of its prejudices may vainly strive to hide the lamp divine under a bushel of follies, yet it is mildly bursting into the face of day in spite of either dullness supreme, or wilful blindness the most obtuse.

Ere such the proud day of success arrives, a vast preparation must be made. We must see distinctly what it is that we want. We must forego all baseless taste; and put a physical taste in its place. Neither papal superstition, nor its opponent scepticism, based on the foolish conceits of vain men, can serve us in the mighty acquisitions to be gained. These have not promoted, but retarded a development of those noblest faculties in man, which alike raise the standard of our religious belief, our moral qualities, and the perfections of our civil institutions. For not a little remarkable is it, that the age, which furnished us architectural remains so splendid, preserved if not matured our free institutions, amidst a period of turbulence and violence disturbing Europe at large. What I humbly ask then is, that men so well qualified as Mr. Cresy and Mr. Bartholomew, should go on and fear nothing.

[These remarks border too much on transcendentatism to be within the usual scope of our columns, but as we know they represent faithfully the ideas of a large class both here and abroad, we should have considered ourselves as neither doing justice to the subject nor the author, had we not availed ourselves of his proffered permission to consult our own taste in suppressing such portions of the paper as were not conformable to our views.—EDITOR.]

* We trust the earned author will excuse us for omitting some too flattering compliments to ourselves.

ENGINEERING WORKS OF THE ANCIENTS, No. 1.

THE PERSIANS.

Engineering has its archæology as well as architecture, the monuments of the Egyptians, of the Persians, of the Romans, are subjects which interest every class of readers. To some it may appear that the profession of a civil engineer is but of modern growth, it certainly may be so considered as regards its recent progress, but to the attentive observer a long chain of history is visible which records the labours of engineers, not for hundreds of years merely, but for thousands. On the engineering profession therefore the contemplation of the works of their predecessors is imposed as a task, if they are at all desirous that their successors should pay the same homage to themselves. The works of classic authors abound with accounts of interesting works, the descriptions of some of which we mean to copy into the Journal, as into a common-place book, trusting that it can never be considered useless to any man to contemplate the glories of the past. For this purpose we shall from time to time put down as they occur to us, extracts from the several authors, who have left materials for the subject of our enquiries.

Our present paper will principally be devoted to the works of the Persians and the Babylonians, which belong to one of the first schools of which we have authentic records. The history of this period forms the first in the annals of engineering, as now taught in this country, for the rudiments of the science laid down by the Persians, have, by successive nations, been transmitted to us. Persia being, like Egypt, a country traversed by a large river, and requiring extensive hydraulic works, naturally led to considerable proficiency in this branch, which would naturally be later of introduction among the continental Greeks, to whom it was taught by the Ionians in the Persian service. The Persian monarchs, independently of their own engineers, also became masters of the services of those of Egypt, Babylon, and Phœnicia, each of which, as we shall see, had also peculiar opportunities of study. From the Greeks engineering passed to the Romans, and so through the middle ages down to the present time, affording an example, paralleled in few professions, of rules of practice being transmitted uninterruptedly for more than twenty-five centuries, and illustrated from the earliest period by specimens now existing.

The materials for the ensuing descriptions are principally derived from Herodotus, who had authentic sources of information as to most of the works which he described. They are, as before stated, chiefly hydraulic works, and illustrate much of the antiquities of that important department of engineering.

CANAL OF MOUNT ATHOS.—CUTTING.—THE GOD OF THE ENGINEERS.

In the course of the war of the Persians against the Greeks about the year 481 B. C., Herodotus* relates that, in order to avoid shipwreck on the dangerous coast of Mount Athos, Xerxes determined on cutting through the isthmus by which it is joined to the mainland, and so making a canal for the passage of his fleet. Herodotus says that three years were spent upon this work, the Persian fleet having been ordered to the port of Eleus in the Chersonese, and all the forces on board being compelled by turns to dig, and open a passage through the mountain. In this they were assisted by the adjoining inhabitants, and the direction of the works was confided to Bubaris, the son o Megabyzus, and to Artachæus, the son of Artæus, both Persians.

Athos is described as a mountain of considerable magnitude, leaning upon the sea, and well inhabited, (now, we may observe, by monks). It terminates to the landward in the form of a peninsula, and makes an isthmus of about twelve stades (a mile and a half) in length. The

* Polymnia 7.

peninsula so formed consists of a plain with a mixture of little hills, from the coast of Acanthus to that of Torone. On the mountain and other parts were the towns of Dion, Olophyxus, Acrothoon, Thysus, and Cleone, and on the isthmus stood Sana. The Persians having drawn a line before the town of Sana, divided the ground among the several nations; and when the trench was considerably sunk, those who were in the bottom stages contrived to dig, and delivered the earth to men standing on ladders, who handed the same again to such as were placed in a higher station, till at last others who waited to receive the burthen at the edge of the canal, carried it away to another place. But by digging in a perpendicular manner, and making the bottom of equal breadth with the top, all the workmen, except the Phenicians, drew a double labour upon themselves: because the earth, as it is natural, fell down continually in great quantities from the upper parts. The Phœnicians alone, continues Herodotus, shewed that ability, on this occasion of which they are so much masters at all times: for they opened the part which was assigned to their care twice as large as others had done; and sloped the ground gradually till they came to the bottom, they then found the measure, equal with the rest. So much for the mode of cutting pursued two thousand three hundred years ago. We are thus enabled to ascertain the origin of the slope, and the period at which its recognized introduction into the art took place. The number of workmen employed, says our author, was so great that in a meadow adjoining they had a market furnished with great abundance of corn brought even from Asia, and there was also a temporary court of justice formed perhaps on the piepoudre system. Herodotus is by no means disposed to approve of the necessity of the work, for he rather ascribes it to ostentation, being of opinion that it would have been much easier for Xerxes to have had his fleet carried over the land. The canal was of a sufficient breadth to carry two ships sailing in front, and at each end were deep trenches to prevent the sea from filling it up, it was completed by the time the Persian army arrived at Acanthus, in the neighbourhood (about 481 B. C.)—At this time died Artachæus, one of the engineers, who appears by all accounts to have been one of the greatest men of the day, for he was in stature the tallest of all the Persians, and wanted only the breadth of four fingers to complete the full height of five regal cubits: his voice also was stronger than that of any other man. By descent he derived his blood from the noble family of Achæmenes, and was much esteemed by Xerxes, who greatly lamented his death, and caused him to be interred with great pomp. All the army was employed in erecting a monument to his memory; and the Acanthians, admonished by an oracle, honoured him as a hero with sacrifices and invocations. "Such," says Herodotus, "were the demonstration which Xerxes gave of his concern for the loss of Artachæus;" and thus did the profession obtain the patronage of a demigod from their own body, to whom if they like they may build temples at this day.—In the meanwhile we suggest to our antiquarian friends, whether the Persian engineers swore by Artachæus, and whether any devout modern would be justified in using the same ancient form.

The fleet, it seems, according to orders from Xerxes, passed through the canal of Mount Athos, and so into the bay on the other side. Our author further adds, that the people of Acanthus, in consideration of the great attention they paid in making the canal, were rewarded by the king with vests of honour.

In the Babylonian district, the people were, as in Egypt, well supplied with canals, principally for the purposes of irrigation, the water being distributed from them by manual labour, or by hydraulic engines. The largest of these canals,* continued with a south-east course from the Euphrates to that part of the Tigris where Nineveh stands, and was capable of receiving vessels of burthen. These canals and the river were navigated by a peculiar kind of skin boat or coracle, to which Herodotus devotes particular attention.

PASSAGE OF RIVERS.—THE HALYS—THE GYNDES—THE EUPHRATES—THE DANUBE—THE STRYMON.

In the course of the war of the Lydians against the Persians, Cræsus found it necessary to cross the river Halys,† when by the advice of Thales, the Milesian it is said, that he caused the river to be divided into two branches, as if he were going to make a bridge—the diversion of streams being a resource well known to the ancient engineers both of the east and the west. He sank a deep trench, which commencing above the camp, from the river, was conducted round it in the form of a semicircle, till it again met the ancient bed. It thus became easily fordable on either side.

Cyrus in his war with the Babylonians made use of a similar expedient, with regard to the river Gyndes, but from other motives. The Gyndes is described by Herodotus (Clio) as rising in the mountains of Matiene, and passing through the country of the Darneans, loses itself in the Tigris. Whilst Cyrus was endeavouring to pass this river, which could not be performed without boats, one of the white consecrated horses boldly entering the stream, in his attempts to cross it, was borne away by the rapidity of the current and totally lost. Cyrus, exasperated by the accident, made a vow, that he would render this stream so very insignificant, that women should hereafter be able to cross it without so much as wetting their knees. He accordingly put off his designs against Babylon, and divided his forces into two parts: he then marked out with a line on each side of the river, one hundred and eighty trenches; these were dug according to his orders, and so great a number of men were employed that he accomplished his purpose, but thus wasted the whole of that summer. It is supposed however that he was induced to undertake this work for the purpose of averting some omen.

On his arrival at Babylon, however, he had to carry on hydraulic works with a more important end. Finding the city strong and well provided, and that its reduction by force or famine seemed impracticable he had to take other measures. He placed one detachment of his forces where the river first enters the city, and another where it leaves it, directing them to enter the channel and attack the town wherever a passage could be effected. After this disposal of his men, he withdrew with the less effective of his men to a marshy part of the river, near which there was a kind of reservoir, said to have been constructed by Nitocris, Queen of Babylon, not long before. Cyrus here pierced the bank, and introduced the river into the lake, by which means the bed of the Euphrates became sufficiently shallow for the object he had in view. The Persians in their station watched the proper moment, and when the stream had so far drawn off as to be no higher than their thighs, they entered Babylon without difficulty.

Darius Hystaspes* in his expedition against the Scythians ordered a bridge to be thrown over the Ister or Danube by the Ionians. It was placed two days passage from the sea, at that part of the river, where it begins to branch off, but of its mode of construction nothing is said, although it may be inferred that it was of boats. Darius, when he arrived at the Ister, passed the river with his army, he then commanded the Ionians to break down the bridge, and to follow him with all the men of their fleet, but by the advice of Coes, a Mytilenian officer, he allowed it to remain, leaving it under the guard of the Ionians, with orders if he did not return in sixty days to break it down. The Scythians knowing this sent a deputation to the Ionians to persuade them to break down the bridge, or to maintain it only for the stipulated time, to which latter proposition they assented. The delay of sixty days having however expired, the Ionians by the advice of Histiæus of Miletus, still maintained the bridge for the Persians, but to prevent the Scythians cutting off the retreat, broke that portion near the Scythian shore. Darius arriving in the night with his army, Histiæus with the fleet restored the bridge.

Bubaris and Artachæus, the engineers of the Mount Athos canal, were also charged during the campaign of Xerxes against the Greeks, with the construction of a bridge over the river Strymon in Thrace. For these bridges, says the author so frequently quoted,† Xerxes provided cordage made of the bark of the biblos, and of white flax. This is all the account we have received of the bridge, except that the army afterwards passed over.

PASSAGE OF SEAS.—BOSPHORUS—HELLESPONT—GULF OF SALAMIS.

Darius,‡ having determined on an expedition against the Scythians, gave orders to throw a bridge over the Thracian Bosphorus, or as it is now called the canal of Constantinople. This bridge was placed at Chalcedon, or as Herodotus conjectors nearly midway between Byzantium and the temple at the entrance of the Euxine, constructed under the direction of Mandrocles, a Samian, who executed it so much to the satisfaction of Darius, that he made him many valuable presents. With the produce of these presents Mandrocles caused a representation to be made of the Bosphorus with the bridge thrown over it, and the king seated on a throne, reviewing his troops as they passed. This he afterwards consecrated in the temple of Juno, with an inscription paraphrased by Beloe thus—

Thus was the fishy Bosphorus inclos'd,
When Samian Mandrocles his bridge impos'd:
Who there, obedient to Darius' will,
Approv'd his country's fame, and private skill.

This is perhaps one of the earliest instances of a votive offering, and of an artistical commemoration of an engineering work.

* Herodotus, Clio.
† Herodotus, Clio.

* Herodotus—Melpomene.
† Herodotus—Polymnia.
‡ Herodotus, Melpomene.

Xerxes the successor of Darius, in his previously mentioned campaign against the Greeks, also had occasion to pass the same sea, but at another point.* While he was preparing to go to Abydos, numbers were employed in throwing a bridge over the Hellespont from Asia to Europe. The coast toward the sea from Abydos, between Sestos and Madytus in the Chersonese of the Hellespont, is described as rough and woody: the distance from Abydos being seven stades, or nearly a mile. The work however commenced at the side next Abydos. The Phœnicians used a cordage made of linen, the Egyptians the bark of the biblos. The bridge was no sooner completed than a great storm arose which destroyed the whole work, which when Xerxes heard, he ordered, as is well known, the Hellespont to be flogged, and a pair of fetters to be thrown into it. The engineers got worse off, for they were sentenced by the king to be beheaded. Our historian goes on to say with some naïveté that a bridge was then constructed by a different set of engineers—which we should naturally imagine, for it is difficult to conceive how men who were beheaded, could very easily preside at works *à la Saint Denis*. The mode employed, as far as it can be made out, was to connect together ships of different kinds, some long vessels of fifty oars, others three banked gallies. These were arranged in a double row, one set transversely, but the other in the direction of the current. When these vessels were firmly connected to each other, they were secured on each side by anchors of great length; they left however openings in three places, sufficient to afford a passage for light vessels, which might have occasion to sail into the Euxine or from it. Having performed this, they extended cables from the shore, stretching them upon large capstans of wood, for which purpose they did not employ a number of separate cables, but united two of white flax with four of biblos. These were alike in thickness, and apparently so in goodness, but those of flax were in proportion much the more solid, weighing not less than a talent to a cubit, an expression showing that the ancients knew how to appreciate the qualities of cordage. When the pass was thus secured, they sawed out rafters of wood, making their length equal to the space required for the bridge; these they laid in order across upon the extended cables, and then bound them fast together. They next brought unwrought wood, (fascines qy.) which they placed very regularly upon the rafters: over all they threw earth, and which they raised to a proper height, and finished all by a fence on each side, that the horses and other beasts of burden might not be terrified by looking down upon the sea. Two ways were thus made, one on each set of boats; on one of these ways, namely, the northern, the infantry and cavalry passed, and over the southern the camp followers and the baggage. The bridge was afterwards destroyed by a storm.

At a subsequent period of the campaign Xerxes contemplating flight, for the purpose of amusing the Athenians, he made an effort to connect the island of Salamis with the continent, joining for this purpose the Phœnician transports together to serve both as a bridge and a wall.

BRIDGE.—EUPHRATES—BRICKS.

Babylon,† being divided by the river Euphrates into two distinct parts, whoever wanted to go from one side to the other was obliged to pass the water in a boat. To remedy this general inconvenience, and mentioned by the historian as an expedient not usual, Nitocris, Queen of Babylon, determined upon building a bridge, from which period we may date the formation of permanent bridges as a part of engineering. Having procured a number of large stones, she changed the course of the river, directing it into a canal prepared for its reception, and so into a large marsh or reservoir. The natural bed of the river being thus made dry, the embankments on each side near the centre of the city were lined with bricks, hardened with fire. Upon this we may remark that the Babylonians used two kinds of bricks, the common brick, baked in the sun, and another brick burnt in a furnace; this latter kind was most probably used on this occasion, as the more durable. Nitocris, then with the stones before prepared erected a number of piers, strongly compacted with iron and lead; on these piers a platform was laid, which was removed at night to prevent communication between the different quarters of the city. The bridge being completed, the river was allowed to return to its natural bed. This work, according to Diodorus Siculus, was five furlongs in length.

EMBANKMENTS.—EUPHRATES—ACES—SLUICES.

Nitocris, just mentioned, is said to have been the author of several other remarkable works, some of which are however, doubtful. Being fearful of the ambition of the Medes, she is said, for the purpose of preventing communication with them by the Euphrates, to have diverted the course of the river above Babylon, by sinking a number of canals, and giving it a winding shape. To restrain the river on each side, she raised banks, which are described as wonderful on account of their enormous height and substance. A large lake or reservoir is also attributed to this queen, its circumference being stated at fifty miles, but it is more than probable that her works were confined to reclaiming part of a natural marsh, or to securing the banks; these she lined with stones brought thither for that purpose.

* Herodotus, Polymnia.
† Herodotus, Clio.

Herodotus relates in his third book an account of operations on the river Aces, on which doubt has been thrown, but which whether true or false, will be equally interesting as illustrating the engineering opinions of the ancients. He says that there is in Asia a large plain surrounded on every part by a ridge of hills, through which there are five different apertures. It formerly belonged to the Chorasmians, who inhabit those hills in common with the Hyrcanians, Parthians, Sarangensians, and Thomaneans; but after the subjection of these nations to Persia, it became the property of the great king. From these surrounding hills there issues a large river called Aces: this formerly, being conducted through the openings of the mountain, watered the several countries before mentioned. But when these regions came under the power of the Persians, the apertures were closed, and gates placed at each of them, to prevent the passage of the river, from which expression we infer that the Persians were acquainted with the use of sluices. Thus on the inner side, from the waters having no issue the plain became a sea, and the neighbouring nations, deprived of their accustomed resource, were reduced to extreme distress from the want of water. In winter they, in common with other nations, had the benefit of the rains, but in summer, after sowing their millet and sesame, they required water, but in vain. Not being assisted in their distress, the inhabitants of both sexes hastened to Persia, and presented themselves before the palace of the king, made loud complaints. In consequence of this, the monarch directed the gates to be opened towards those parts where water was most immediately wanted, ordering them again to be closed after the lands had been sufficiently refreshed: the same was done with respect to them all, beginning where moisture was wanted the most. This, however, was only granted in consideration of a large donation over and above the usual tribute.

That the Persians were well acquainted with the operation of damming appears also by other instances. Xerxes having examined the Peneus, a river of Thessaly, inquired whether it could be conducted to the sea by any other channel, and received from his guides, who were well acquainted with the country, this reply: "As Thessaly, O King, is on every side encircled by mountains, the Peneus can have no other communication with the sea." "The Thessalians," Xerxes is said to have answered, "are a sagacious people. They have been careful to decline a contest for many reasons, and particularly as they must have discerned that their country would afford an easy conquest to an invader. All that would be necessary to deluge the whole of Thessaly, except the mountainous parts, would be to stop up the mouth of the river, and thus throw back its waters upon the country."

(To be continued.)

A SUBSTITUTE FOR CHIMNEY-POTS.

Sir—Owing to the many accidents which have occurred through the late storm, from the falling of those ugly and useless appendages (called chimney pots), which disgrace the noble works of architecture in our metropolis, I am induced to trouble you with a few lines, should you consider them worthy of insertion in your valuable publication. It has frequently been a subject of my thoughts, how chimney pots were first introduced, as they certainly are most useless and unsightly articles.

Perhaps, if I draw the attention of your readers to the form of a tin horn, such as is used by guards of mail coaches, the principle of chimneys will be better and more easily understood; if builders will only try the experiment, I feel satisfied they will no longer continue one of the greatest imperfections of our common system and mode of building. If the large end of the horn be placed downward over some ignited bituminous matter, we shall find only part of the smoke will ascend; but if we place the small end down, we shall not only find the draft greatly increased, but the smoke will ascend freely up the tube.

Hoping these observations will be of service to the public,

I remain, Sir,
Your obedient servant,
J. R. B., C.E.

Brixton Road,
January, 1841.

REMARKS ON THE MORTAR USED IN ANCIENT BUILDINGS.

WITH OBSERVATIONS AND DIRECTIONS FOR PREPARING MORTAR IN A MORE PERFECT MANNER THAN THAT NOW IN PRACTICE.

The great perfection to which the arts have attained cannot be denied; yet on examining the monuments of former ages, of which many are still to be seen in this country, it does appear that the ancients had some manner of making and using mortar for their buildings, of which our modern artists seem either to be ignorant, or do not choose to put in practice. Although the grand edifices raised under the direction of the artists of the present age, is a proof that our modern masters, by the study of the monuments left us by the ancients, have been enabled to construct buildings vying with their patterns; yet the moderns are still behind the ancients in the construction of buildings with small or promiscuous materials, with that degree of solidity which seems almost to set time itself at defiance.

There is no doubt little difficulty in raising lasting edifices by building immense blocks of solid stone, one upon another—but if we say nothing of the enormous expense of this mode of construction, even where the materials are to be found in the vicinity, there is some consideration necessary when works which require durability are to be constructed, where no large materials can be readily found. Hence the erection of buildings which may be of the utmost importance in a national point of view, as well as to individuals, has to be abandoned, on account of the enormous expense attending the modern plan of construction.

On a careful examination of many of the old castles in this country, it will be seen that the materials which have been used are of the most ordinary kind; and from the manner in which they have stood for such a long period of time, it does most readily occur, that the mortar used in these buildings, has been prepared in a different manner from that practised by modern builders. In fact it will be found that many of these old buildings have been put together with almost every description of stones down to the smallest pebble collected from the bed of the brook, and where no heavy carriages or complicated machinery have been required to construct the most extensive works.

Our ancient bridges and aqueducts all exhibit specimens of the same kind of construction with very small stones; depending therefore on the superior manner of preparing the mortar by which these small materials have been cemented together.

Thus there seems to be an art lost, and in place of endeavouring to recover this art by a series of well conducted experiments, men of genius, and particularly our modern philosophers, seem to have principally in view to bestow their labours in pushing into the world books filled with abstract calculations which they understand only on paper. These calculations are, however, by far too nice, and it is much to be feared that few of the writers could be found to reduce them to practice—and as practical men do not understand them, they are useless to the world. It may be very well for the physician to write a learned prescription intermixed with hieroglyphics, to the apothecary who understands it; but alas! the carpenter and builder have neither time nor inclination to enter into the abstruse analysis of the philosopher. Bred to labour from their early youth, it is only from experience they are accustomed to learn; and it is therefore only from a course of well regulated experiments, described in plain language and simple figures, that the labouring artist's attention can be arrested.

It would therefore in almost all cases be the means of more rapidly diffusing a knowledge of the useful arts, were our seminaries furnished with the means of exhibiting in some degree of experiment, specimens of the various useful arts. For without experience what is the young engineer who is sent forth to direct the operations of a siege, to raise fortifications, form aqueducts, or construct bridges? It is clear he has yet to learn from the labouring artificer, the essential parts of his business; and thus he is sent forth only with the name, to learn from those of inferior station, who are here found capable of giving instructions from experience, where fine theories and abstruse analysis can be of little avail.

To return, however, to our ancient buildings, where it appears neither time nor labour was lost in the execution. Many of them seem constructed of little else than rubbish thrown together with an outer coating of small stones, or pebbles from the brook, but built with a kind of mortar which appears to have been thin enough to penetrate the smallest crevices, and to form a solid, compact, nay almost an impenetrable body. And if the ruins are considered with the smallest degree of attention, it will convince us that all the secret of this mode of construction, consists in the preparing and using the mortar which has bid defiance to time, and to the tools of the quarrier to remove, after the lapse of ages. Every workman who has been engaged in taking down any of our old castles, will testify that he has always been able to remove the stone with greater facility than he could disengage the mortar.

How differently then must this mortar have been prepared from the very best which is now prepared by our modern builders: for the latter only dries to fall to dust again when broken into. Another of the grand qualities of the ancient mortar is its being impenetrable to water; and, in fact, the aqueducts for retaining and conveying water which are still to be seen, exhibit no marks of clay or other kind of puddle having been used for retaining the water. Therefore, it does appear that aquatic as well as other works, were frequently constructed of very small stones, by the builders of former ages, and that they were in the practice of forming parts of their buildings into cases or *caissons* of planking, by which means the mortar when run in amongst the interstices of the small stones, was prevented from escaping.

It can therefore be most readily conceived how easily a building of great magnitude may be constructed at a small expense, and that of the most durable and lasting kind, of materials with which almost every part of our country abounds, if we are only careful in the preparation of the mortar with which these materials are to be cemented together.

It does not appear that the ancients used any other ingredients in their mortar than lime, sand, or calcined earth, such as brick dust, when proper sand could not be procured; and therefore, as already mentioned, the whole secret seems to be the manner of preparation, of which some explanation will now be attempted.

It is presumed the fact is well known, that in the burning of limestone, the fixed air which it contains escapes, and the stone by this means loses its weight. It has indeed long been the practice to grind or slack the lime immediately after being burned, and by means of mortar mills (where the extent of the works can afford them) to prepare the hot mortar for immediate use for building or bedding large materials; but, it is a fact well known that this kind of mortar (to say nothing of the great expense of procuring it), would be useless in ordinary buildings, as the weight of the substance in thin walls composed of small materials, would not prevent the burstings, cracks, and sets, which would take place; nor, from the consequence of blistering which always happens when mortar prepared in this way, is used; rendering it unfit for plastering either to withstand the action of the weather, or for lining water courses: because it suddenly dries by the evaporation of its moisture, and consequently, immediately gives way to cracks and shrinking.

On the other hand lime-mortar after lying a considerable time in a sowered state, imbibes again the fixed air which was discharged in the process of burning, and when carefully examined in this state, presents a kind of transparent, or rather icicle, appearance, which destroys in a great measure the binding quality, and which, in our changeable climate, rarely or ever has the effect of cementing the building. The latter, however, is the manner in which almost all the lime mortar is most commonly prepared for building, both from a regard to economy as requiring less lime, and also with regard to labour; and, it is more than probable it was by hand labour also, that the builders of former ages prepared their mortar. It is therefore to this principle that observations have been directed, of which the following notice is submitted, and which it is hoped, if properly attended to, will enable those who wish to do so, to prepare and use lime-mortar not inferior to that of the ancients.

Sower together a quantity of lime and clean sharp sand for two or three weeks before being used; work this well and turn it aside, and as the proportion of the lime to the sand, will always depend on the quality of the former, all that is necessary is, to take care (in sowering), if the lime is of a rich quality, to put one-third less lime into the heap, than it is intended to be built with; and, if the lime is of poor quality, say only one-fourth less. (It may here be observed that in general lime of the poorer quality is best for cementing building.) When the lime which has been previously sowered, as before directed, is to be used in the building, or otherwise, it is to be again worked carefully over, and one-fourth of quick lime added in proportions, taking care never to have more in preparation than can be used in a short time; and this quick lime should be most completely beaten and incorporated with the sowered lime, and it will be found to have the effect of causing the old lime to set and bind in the most complete manner. It will become perfectly solid without the least evaporation to occasion cracks, which can only ensue in consequence of evaporation; and this can only happen from the want of proper union between the two bodies. But by mixing and beating the quick lime with the sowered mortar, immediately before it is applied to use, the component parts are brought so near to each other, that it is impossible either crack or flaw can take place. In short beating has the effect of closing the interstices of the sand, and a small quantity of lime paste is effectual in fitting and holding the grains together, so as to form a plastic mass by uniting the grains of sand which otherwise would not fit each other. This system will apply to lime-mortar for all descriptions of work, whether for building, plastering in the inside or outside of houses, water cisterns, ground vaults, rough casting, &c. &c.

It may not be improper to mention that whenever there is any difficulty in procuring proper sand for building, clay is an excellent substitute; and all that is necessary is, to make it into balls, and burn it, and then pound it like brick-dust, or pozzolano earth. There is no doubt, in addition to the superior scheme of making mortar in former ages, that, when they used only the small stone, which we see in the ruins of their buildings, they were in the practice of using temporary casings of boarding which they could move from place to place as the building advanced, and which would enable them to grout or fill up with their quick mortar all the interstices in the successive layers of stones. And moreover, by having the boarding of their centering for arches and conduits quite close, they were enabled to lay on, along with their stone, almost an impenetrable coating of plaster.

From the foregoing observations, it is hoped, it will be most clearly seen that an easy mode of erecting substantial and durable building is generally within our reach, and that the most inferior kind of stones may be used, providing proper care is taken in the preparation of the lime-mortar with which they are to be cemented together.

John Gibb,
M. Inst. C.E.

Aberdeen, January 2, 1841.

ON THE CONSTANCY OF CALORIFIC ABSORPTION,

EXERCISED BY THE BLACK OF SMOKE AND BY METALS; AND ON THE EXISTENCE OF A DIFFUSIVE POWER, WHICH BY ITS VARIATIONS CHANGES THE VALUE OF THE ABSORBING POWER IN OTHER ATHERMANTIC BODIES.

(Translated from the French of M. Melloni, *for the* C. E. & A. Jour.*)*

There were great difficulties to be overcome in the attempt to prove that the black of smoke, subjected to the action of different kinds of radiating heat, always absorbs the same proportions of them. The question would be immediately solved if we could successively expose the blackened body to equal radiations, drawn from several sources of caloric; for a thermometer plunged in the interior of the body would show by the greater or less elevation of temperature, whether the quantities of heat absorbed vary or not with the quality of the incident heat. When however we come to use the thermometer or thermoscope in experiments on radiating heat, it becomes necessary, as we shall hereafter see, to cover them with the black of smoke. On the other hand, to compare two forces, whatever the effect which they produce upon the measuring instrument must be estimated exactly in proportion to their intrinsic energy. Thus we cannot compute the relative intensity of rays of heat but by admitting the principle in question: the experiment therefore of a thermometer plunged in the interior of the body would be quite illusory.

The first operation is to take a disc of wood, of which one face is white and the other black; this is fixed vertically upon a stock moveable upon its axis, and having successively brought the two surfaces by a half revolution of the disc in presence of the radiation of a lamp concentrated by a glass lens, each time is collected with a very sensible thermometer provided with a reflector, the secondary calorific radiation projection by the side on which the direct rays fall, after this radiation has traversed a plate of glass interposed between the disc and the thermometer. In the case of the black face there is no sign of heat; but things are different with regard to the white face, from which is obtained a very intense indication of caloric. It is well known that white bodies can never be heated more than black bodies under the influence of any radiation whatever, and under the circumstances of the experiment the black face gives nothing; therefore the great action of the white face does not arise from the absorbed heat, but from a true dispersion, similar to the diffusion suffered by luminary rays and the exterior of opaque bodies. To prove the variable diffusive action which a white surface exercises on calorific rays from different sources, and the constant absorption of the black of smoke in all kinds of heat, a very sensible thermometer is used with a reflector, carefully sheltered from rays direct from the source and by it are measured the true secondary anterior and posterior radiations projected from the surface of an immoveable disc subjected to a given radiation. The same observations are repeated for several kinds of heat by employing two discs of thin cardboard, one painted black and the other covered with a substance more or less white The first of these discs constantly exhibits the same relation between the rays vibrated by the two faces, the second shows very different relations. Underneath is shown the relative results of four species of rays arranged according to the order of the temperature, of the sources from which they emanate.

Black disc	$\frac{10}{12}$	$\frac{10}{12}$	$\frac{10}{12}$	$\frac{10}{12}$
White disc	$\frac{10}{14}$	$\frac{10}{18}$	$\frac{10}{26}$	$\frac{10}{34}$

In order to enable us to draw conclusions from these figures, it is for the present to remark that the posterior face of each disc radiates in consequence of the heat absorbed while the anterior face acts at the same time by virtue of the radiations caused by absorption and diffusion; we therefore see 1st. That the black of smoke absorbs and disperses all kinds of calorific rays with the same energy. 2nd. That the diffusibility of caloric on the surface of the white disc increases with the temperature of the source.

As a detail of the other experiments would require too great a space, it will be sufficient to sum up here the general results.

1. The superficial layers of bodies cause to radiating heat a dispersion analogous to luminous dispersion.

2. We possess sure means of distinguishing calorific diffusion from the radiation derived from the proper heat of the body, notwithstanding both radiations are equally composed of elementary pencils radiating in every direction around the centre of action.

3. The black of smoke produces very little diffusion equal for all kinds of radiations.

4. That other substances, and especially white bodies are very different, as they strongly disperse rays from incandescence, and weakly disperse those which derive their origin from sources of temperature.

5. This special characteristic is enough to show that we must not attribute the phenomenon of calorific diffusion to every regular or irregular reflection whatever; for this would take place with the same energy for all kinds of heat.

6. The dispersive action of metals is generally speaking more intense than that of white bodies: it especially differs by its invariability, and on this point resembles the feeble diffusion observed in the black of smoke.

7. By comparison between the phenomena of calorific diffusion and those of luminous diffusion, it appears 1st. That the black of smoke is a true black matter, both as regards radiating light and heat. 2nd. That white bodies act with regard to radiating heat as coloured substances with regard to light. 3rd. That metals act upon calorific radiations as white bodies do upon luminous radiations.

8. The diffusion sends back a part of the incident rays proportionate to its intrinsic energy, and thus diminishes the calorific absorption of the whole portion of heat dispersed by the action of the surface.

THE PNEUMATIC MARINE PRESERVER.

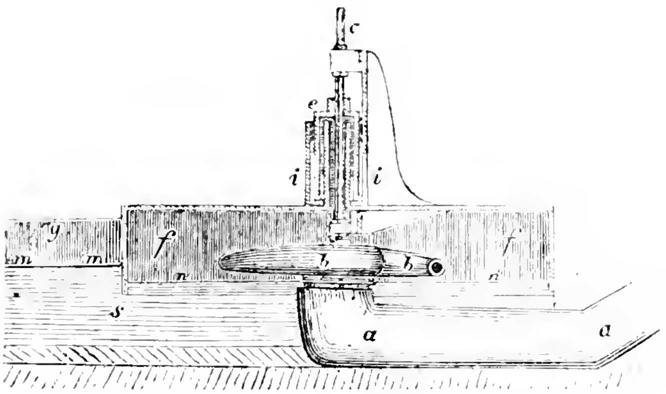
Sir—In viewing the many interesting and scientific exhibitions at the *Polytechnic Institution* in Regent Street, my attention was more particularly arrested by the model of a ship fitted up with a new invention, called the Pneumatic Marine Preserver: indeed, I was astonished to see the little vessel, though full of water and cargo, still keep afloat, and to a casual observer's eye, without the least aid, as the apparatus occupies so little room, and is so placed out of the way, that ninety-nine out of a hundred would not observe the reason of its buoyancy. While carefully examining the craft, a person who shows it to the public, suddenly exhausted the air, and she gradually sunk completely out of sight; but to my surprise, by a few strokes from the condensing air-pump, she immediately rose to the surface of the water, and again floated about.

Being an old sailor, I thought it a duty I owe to my fellow creatures to make it known to the public through your valuable Journal: and I would particularly advise captains to have their boats fitted up with the Patent Pneumatic Marine Preserver, as, in case of danger, they then become perfect life-boats, far superior to any yet invented for room, lightness, and buoyancy. If ever there was an invention of incalculable service to sea-faring men this is the one, and deserving of their utmost attention if they value life or property.

I remain
Your obedient servant,
An Old Sailor.

London,
January, 1841.

IMPROVEMENT IN MESSRS. WHITELAW AND STIRRAT'S WATER-WHEEL.



In the "Mechanics' Magazine" we have a suggestion for an improvement in Messrs. Whitelaw and Stirratt's Water Wheel, given in last month's Journal, of which the accompanying drawing shows the plan, which, with the assistance of Mr. George Whitelaw, Mr. James Whitelaw has invented for keeping the new patent water-mill out of tail-water. *a a* is the main-pipe, *b b* are the arms of the machine, and *c* is the top of its shaft. The arms work inside of an air-vessel *f f*, which is fixed down to a building, and is covered on the top, but has no bottom. The shaft passes freely through a hollow cylinder fixed above an opening in the top of *f f*, and there is another hollow cylinder *i i*, fixed also on the top of *f f*, and so large in diameter inside as to leave room for a third cylindrical part *e*, which is fixed upon the upright shaft to revolve easily in the space left between the other two cylinders. The top of *f f*, forms a bottom to the space which is between the two cylindrical parts first named, and *e* is fixed upon the shaft in such a manner that the joining will be air-tight. An inspection of the drawing will make the arrangement, &c., of the cylindrical parts intelligible. *g* is one side of the tail-race; *s* is the opening through which the water escapes from *f f*, into the tail-race.

Suppose now the space into which the cylinder *e* works sufficiently filled with water to form an hydraulic joint of the kind very commonly used in gas works; then, if the machine is set in motion, the air, which will in some instances be disengaged from the water, will remain in the vessel *f f*, and press down the surface of the water in it to the level *n n*, or even lower. In this way, the arms of the machine, although on a level below that of the surface *m m*, of the water in the tail-race, will work clear of the tail-water.

It may be found necessary to use a small pump to force air into *f f*, in order to lower the surface of the water. By running a quantity of water from the main pipe into the air-vessel through an arrangement of pipes similar to the water-blowing machine, air will be carried into *f f*. The space within which the cylinder *e* works may be supplied with water by a small pipe leading from *a a*.

A water-mill composed of two round plates, the one forming the top, the other the bottom of the passages for the water, with plates on edge and properly bent, running between them from the centre outwards, so as to make the space between the round plates all into arms, will work very well in tail-water. If a ring, projecting downwards is fixed to the under plates, then the bottom of the machine will rub on a film of air, instead of on water, and thus the friction will be diminished. This plan may be used instead of the one herein described, in certain cases.

IMPROVED JACQUARD APPARATUS.

A machine has recently been added to the mechanical department of the Salford Mechanics' Institution which promises for it a great increase of attraction. It is an invention of a gentleman of this town, and is called a Jacquard apparatus. When appended to looms moved by power (as in the present instance), or otherwise, it is capable of producing, either on light or heavy fabrics, not only a greater variety, but also a wider and more extensive range of pattern than any other kind of loom; it makes a top and bottom shed of any required depth, without the aid of weights and springs being attached to the healds. The design is formed, and may be varied at any moment by the application of paper cards, or wooden logs and pegs. It will weave with any number of shafts, from 2 to 30; and any length of pattern, up to 5,000 picks may be produced by it. The invention is a very important one to manufacturers. Other articles have likewise been added to the collection within the last few days, but our limits at present prevent us from adverting to them.—*Manchester Guardian.*

BIOGRAPHICAL NOTICE OF THE LATE MR. WILLIAM HAZLEDINE, IRON FOUNDER AND CONTRACTOR FOR PUBLIC WORKS.

(From the Shrewsbury Chronicle.)

With deep and sincere sorrow we record the death of our respected and endeared townsman, the eminent iron founder, William Hazledine, on Sunday, October 26, at his house in Dogpole, in the 77th year of his age.

It would be almost criminal to permit such a man to drop into the grave like an ordinary human being, and therefore we hastily present a few incidents in his busy and honourable career through life.

William Hazledine was born at Shawbury, and his parents removed, while he was very young, to a house at Sowbatch, near a Forge at Moreton Corbet, now Moreton Mill, about seven miles from this town. His father was certainly not wealthy: but his ancestors were highly respectable, their remains occupying tombs in the church-yards of Shawbury and Moreton Corbet: and these tombs the deceased, with filial regard, caused to be repaired a few years ago; he also presented two handsomely carved oak chairs for the altars of both those churches.

During sixteen or seventeen of his early years he worked around the vicinity as an operative millwright. His uncle, under whom he was chiefly brought up, was a man of considerable ability as a millwright and engineer; and, discerning the steadiness and talent of his nephew, he recommended young Hazledine, only 16 or 17 years old, to superintend the erection of machinery at Upton Forge, the property of the Sundorne Family: this was executed most satisfactorily. He afterwards became the tenant of this forge, and the farm belonging to it, and so continued in after life.

After the patronage of his uncle he removed to Shrewsbury, and entered into partnership with Mr. Webster, in Mardol, then a clock-maker, but afterwards an ironmonger and the patentee of a washing-machine. Their first foundry was in Cole-hall, or Knucking-street, in this town; but the speculative and energetic mind of Hazledine having increased the business, more space for workshops, and an increased expenditure for that purpose, amounting to about 2,000*l.*, were necessary: his partner being cautious and timid, a dissolution of partnership took place.

Mr. Hazledine purchased the ground in Coleham, where his present foundry is situated, which has now four gables fronting the road. He prudently first erected one workshop, which occupied only one of these gables; but as business increased he extended his shops, and numerous other erections in the vicinity. He subsequently occupied a foundry near Ruabon, iron works at Calcott, lime works at Llanymynech, timber yards, brick yards, and coal wharfs, in various places.

About this time Billingsley iron mines, near Bridgnorth, were offered for sale in Chancery. Hazledine attended the sale in London, and found there was some jockeyship employed to depreciate the property, and prevent the sale, certain parties being anxious to purchase the works without any competition. Hazledine's sagacity saw the trick; he bid with spirit: at length one of the parties, who wanted to purchase, came to him, and whispered—

"Do you know what you are doing? These mines and works have not a good title, and you will have to pay the expenses in Chancery if you purchase them."

In an audible voice Hazledine answered—

"A bad title to the property, is it, eh? and a Chancery suit, too, eh? Well, I have bought many things, and I will now try to buy a Chancery suit.

He did purchase the property, but immediately sold it, gaining several thousand pounds. The property finally turned out ruinous to the speculators.

In November 1804, at midnight, a fire took place in a room which was the receptacle for his patterns for castings. Mr. Hazledine was from home, but his wife (a daughter of Mr. Brayne, of Ternhill), an uncommonly strong-minded woman, heard the cry of "Fire in Hazledine's foundry," whilst in bed with her infants, and immediately getting up, gave directions for saving the books, papers, and other valuables, which caused their rescue from the flames, whilst a vast quantity of other property was consumed with the building. Mr. Hazledine was then the captain in a company of volunteers; and his company, comprising chiefly his own workmen, was merrily called "The Vulcans." The colonel, Sir Charles Oakely, Bart., and the whole corps, were roused, and much property was saved. It was estimated that the loss was 1,500*l.*, and that about two-thirds were covered by insurance.

Undaunted by the calamity, he rebuilt and extended his foundry, and carried on his various speculations, above enumerated, with great energy. Thomas Telford, who in after life became the celebrated engineer, had been patronised by Sir William Pulteney, and employed in reconstructing some parts of "The Castle" in Shrewsbury, became acquainted with Hazledine, and these kindred spirits formed an intimacy which lasted through life.

Telford soon after was engaged in constructing the Ellesmere and Chester Canal, and Mr. Hazledine became the contractor for the Chirk and Pontycysylte Aqueducts, the latter being one of the most magnificent works of the kind in Europe, which he completed so entirely to the satisfaction of Mr. Telford and the proprietors, that he was immediately engaged in all the national works in which the Government at that time plunged. The erection of the stupendous locks on the Caledonian Canal was entrusted to him, and executed to the entire satisfaction of the engineer and the country.

Hazledine's fame was now established, and he was employed in a series of great works. The following is a summary :—

Pontycyssyle cast-iron Aqueduct over the river Dee, and the valley at Llangollen, in 1802.

A Bridge, 150 feet cast-iron, over the river Bonar, in Scotland.

A Bridge, 150 feet ditto, over the river Spey, in Scotland.

The Lock-gates on the Caledonian Canal.

The beautiful Waterloo Bridge, 105 feet span, near Bettws-y-Coed, on the Holyhead road.

The iron Swivel Bridges at Liverpool Docks.

The Liverpool New Market Columns.

A Bridge, 150 feet span of one arch, and two arches of 105 feet, over the river Esk, near Carlisle.

The Menai Suspension Chain Bridge.

The Conway Suspension Chain Bridge.

The Iron Roofs for the Dublin Custom House and Store-houses.

The Iron Roofs for Pembroke Stores, &c.

Many Swivel Bridges for Sweden.

A large quantity of three-feet Pipes for India, Demerara, &c.

A Bridge built for Earl Grosvenor, 150 feet, at Eaton Hall.

A Bridge over the Severn at Tewkesbury, 170 feet span.

A new Bridge over the Dee, 105 feet span.

A Bridge for Earl Morley, at Plymouth, comprising five arches, of 100 feet, 96, and 81 feet span.

A Bridge at Bath.

Holt Fleet Bridge, 150 feet, over the Severn, near Worcester.

The Swivel Bridges at the London Docks.

The Marlow Chain Bridge.

Montrose Chain Bridge.

Several small Iron Bridges in this county, and many others all over the kingdom, besides the Lock-gates on the Ellesmere and other Canals.

At the present moment, Hazledine's foundry is executing a very extensive work, namely, several pairs of iron lock-gates for Newport, in Monmouthshire, South Wales, each pair weighing 120 tons, the largest ever executed.

In 1832, when the present Queen, then Princess Victoria, and her august mother, the Duchess of Kent, honoured the Earl of Liverpool with a visit at Pitchford Park, near this town, Mr. Hazledine had the honour of receiving, through the Earl of Liverpool, the commands of the Royal personages to wait upon them at Pitchford Park, and explain the principles and construction of the Menai Suspension Bridge —Hazledine's greatest work. The Royal party expressed great satisfaction at the lucid and instructive manner in which the explanations were given, and the tact and shrewdness displayed in Mr. Hazledine's answers. Persons who were present describe the interview as most interesting. Mr. Hazledine received a present as a token of approbation; and we cannot avoid adding, from personal knowledge, that her Royal Highness the Duchess of Kent, when she passed over the Menai Bridge, examined every part of it minutely, according to Mr. Hazledine's description, and even entered the caves in which the iron suspension cables are fixed.

This is a slight view of Mr. Hazledine's public works, and it gives a portrait of him as a practical man. There are other features, which we are unable to paint with the warmth and fidelity which they deserve. His strong affection for the members of his family rendered his fireside one of the most happy round which an English family ever gathered. He was ever devising some simple means of increasing their enjoyments; and he attended personally to everything in which their comforts were involved. At that trying season, when the wheel of the "Union" coach locked into that of his gig on the Wyle Cop, and overthrew him and shattered his arm in several places, and he was carried home in such plight as threw his affectionate wife into such agony as deprived her of life by a disorder arising from the grief she suffered from his illness—even in that accumulation of sorrows his presence of mind and affectionate care never for a moment ceased; and whilst his face was suffused with sweat from the extreme agony he was suffering from the bone of his arm having to be *again* broken by the surgeon—even then he took upon himself the whole preparation for the funeral of his beloved wife, down to the minutest fittings up of the coffin and funeral clothes; and what all his own sufferings could not wring from him, he gave way to with the utmost bitterness when the dead body of her he so much loved was carried into his chamber, that he might kiss it before it was for ever removed from his sight!

As a master he was kind and considerate to all employed under him; his workmen, if they conducted themselves well, became grey, and died in his service. In our obituary last month we recorded the death of John Maybrey, sen., who had been upwards of 40 years in the employment of Mr. Hazledine, who, indeed, reminds us of Addison's character of Sir Roger de Coverley :—"You see the goodness of the master even in the house-dog, and in his *grey horse*, that is kept in the stable with great care and tenderness, out of regard to his past services, though he has been useless several years."

The religion of Hazledine was also somewhat characterised by Addison :—"Nothing is so glorious in the eyes of mankind, and ornamental to human nature—setting aside the infinite advantages which arise from it—as a strong, steady, masculine piety: but Enthusiasm and Superstition are the weaknesses of human reason—that expose us to the scorn and derision of Infidels, and sink us even below the beasts that perish."

A very short time before he was confined to bed by his last illness, a nobleman, equally distinguished by his literary and legal talents, and filling one of the highest situations which a subject can occupy, arrived in the town, at a little before seven in the morning, and inquired at the Lion if Mr. Hazledine was likely to be up?

"Oh yes," was the reply; "he passed here an hour and a half ago, on his way to the foundry."

"I regret that," said his lordship, "for I wanted a few minutes' conversation with him, which I cannot now have; but tell him from me, that Lord —— inquired after him, and is happy to hear he is so well. My belief is," added his lordship, "that William Hazledine is the first practical man in Europe."

PROPOSAL FOR ESTABLISHING A BRITISH ASSOCIATION FOR THE ADVANCEMENT OF THE FINE ARTS.

A knowledge and consequent due appreciation of the fine arts,—the arts which purify and ennoble,—are now observable amongst much larger masses of persons in the metropolitan cities of the United Kingdom, than was the case twenty years ago; and must inevitably go on to augment in a greatly multiplied ratio, as every step gained becomes the means of further advances. In the provinces, too, where there are fewer "appliances and means to boot," the attention of the people to the importance of the fine arts as civilizing agents, and as tending to promote the general good and therefore the general happiness, has visibly increased, and has manifested itself in more than one good result. Still there is a wide field here open for exertion; and so undeniably important is the object to be attained, so vast is the good that would result from spreading a taste for the fine arts throughout the country, and inculcating a love of the beautiful, that no efforts could be too great, no scheme of operations could be too extensive, which should propose to effect it.

Experience shows the advantages which have resulted from the establishment of the "British Association for the Promotion of Science," not chiefly to science *per se*, although these have been great and manifold, but to the people generally: attention has been awakened in the minds of thousands to subjects before unthought of; a spirit of inquiry has been induced: and whole towns innoculated with an admiration of knowledge, and a determination to pursue it, to the exclusion of demoralizing sources of excitement, until then indulged in. Why, then, might there not be formed an association for the encouragement of ART, which, like this, should meet annually at a different town in England, Ireland, or Scotland, and at which meeting painting, poetry, sculpture, architecture, &c., &c., in all their varieties, and with all their ramifications, should form the subjects for the consideration of the different sections. A large and important exhibition of works of art might be collected, and an Art-Union arranged so as to secure the sale of a certain number of them, and thus to ensure the assistance of the most eminent artists, by rendering the society directly as well as indirectly advantageous to them. A small subscription (say of one pound) would constitute a member of the association for the year, the aggregate of which, after deducting the expenses necessarily incurred, would probably enable the committee (which should be partly local, partly general) to offer prizes for competition in the higher branches of the various arts, and vote sums for the encouragement of any desirable object, in connexion therewith; such, for example, as for the prosecution of experiment in the preparation of colours, the manufacture of stained-glass, or for the purchase of particular pictures, worthy of national regard.

During the meeting the various local collections would be thrown open to inspection: conversazioni would be held; and other means adopted to bring men into contact with each other, on one common ground. One of the first points to be achieved by the united sections would be, to obtain an able and correct report of the progress of Art in England, Ireland, and Scotland, for the last fifty years—a task to be fulfilled satisfactorily only by the joint co-operation of men in all parts of the country. This report would afterwards be continued from year to year, under its various heads, and could not fail to prove a work of the highest interest and value. It is not here attempted, however, to point out what *could* be done by a society organized on the footing suggested: its power of effecting much good must be apparent to all, and needs hardly to be insisted on. The writer is contented simply, but with great earnestness and but one object, namely, strong desire to serve the cause the Art (the cause of morality and public good), to state the proposition, in the hope that others of more ability, influence, and leisure, may view it as it has appeared to him; and be induced to carry it into execution, efficiently and forthwith.

George Godwin, Jun.

Pelham Crescent, Brompton,
January, 1841.

WOOLF'S DOUBLE CYLINDER ROTARY ENGINE.

Sir—In your number for December last, I read a very interesting account of the communication made at the annual meeting of the Manchester Geological Society, by Mr. William Fairbairn: Mr. Fairbairn paid a just tribute of praise to the late Mr. Woolf, by acknowledging the real services rendered by his single engine in Cornwall particularly, and to science generally, in consequence of the undoubted progress made by his application of high pressure steam employed expansively. Mr. Fairbairn's remarks were the more gratifying, inasmuch as the exertions of Mr. Woolf appear generally to be in a state of perfect "oubli," although there can be very little doubt, that he was the first after Mr. Watt to give an impulse to the progress of the Cornish engine, and that much more is due to him than has been generally acknowledged, this circumstance reflects honourably on Mr. Fairbairn's proceeding, to whom much praise is due for his just observations, and for bringing before society a name that is little known, and more honoured abroad than at home.

The principal object of my present application to you is to request, that you will give place to the following observations relative to Mr. Woolf's double cylinder rotary engine, which being but little used in England, has been hitherto very much neglected. I am of opinion that this engine, if better known, and if patronized by engineers of enterprising genius, and in "good repute," would very generally be preferred to every other known system: I speak after having had long and solid experience, and having been in the habit of actual observation abroad, on many hundreds of engines upon different systems, I can very confidently assert, that Woolf's engines when properly made, will work quite as well as any other engine, and will perform the same duty with a consumption of coal that will not exceed *five pounds* per horse power per hour: I have seen many engines of this description doing very satisfactory duty with less.

I have had several opportunities of conversing with manufacturers, who having had low pressure engines, have contracted with engineers to have their cylinders and boilers replaced for the purpose of applying Woolf's principle, and they have invariably declared that they have effected a saving of upwards of one half of the fuel.

I will cite for example an engine on Woolf's principle erected in a mill for rolling zinc and lead, and for drawing pipes. The dimensions of this engine were as follows.

Area of small cylinder, 207·39 square inches.
Stroke of small piston, 4·59 feet.
Speed of piston per minute, 176·34 feet.
Area of big cylinder, 660· square inches.
Stroke of big piston, 6·3 feet.
Speed of piston per minute, 242· feet.
Pressure of steam in the boiler tending to escape into the external atmosphere, 40 lb. per square inch.

The capacity of the small cylinder naturally determines the quantity of steam that the boiler must supply, and allowing that the cylinder fills with steam of an elastic power equal to that in the boiler, and admitting that the big cylinder produces the same effect as the cylinder of an ordinary low pressure engine, the total power of the above engine may be computed in the following manner.

Area of each cylinder in square inches, × pressure of steam per square inch, × speed of piston in feet, and the product divided by 33000 lb. one foot high per minute per horse power, will give the computed power of each cylinder.

$$\text{Small cylinder } \frac{207{\cdot}39 \times 40 \times 176{\cdot}34}{33000} = 44{\cdot}32 \text{ H. P.}$$

$$\text{Big cylinder, } \frac{660 \times 10 \times 242}{33000} = 48{\cdot}40 \text{ H. P.}$$

Computed power of the engine	= 92·72 H. P.
If we deduct for friction one-third	= 30·92
The effective power will be	= 61·8 H. P.

I will call her a 60 horse engine.

To ascertain the quantity of coal this engine will burn, it will be requisite to determine the quantity of water that must be evaporated, to produce a sufficient supply of steam, which can be done as follows:

$$\frac{\text{The area of the small cylinder in sq. inches} \times \text{by the speed in feet}}{144} =$$

capacity of small cylinder in cubic feet per minute.

$$\frac{207{\cdot}39 \times 176{\cdot}34}{144} = 254 \text{ cubic feet,}$$ representing the space occupied by the action of the piston in one minute, and if we add thereto one-tenth for the steam ways, and the space between the top and bottom of the cylinder and the piston, we shall find that the boiler must supply per minute, $254 + 25{\cdot}4 = 279{\cdot}4$, or say 280 cubic feet of steam, under a pressure of 40 lb. per square inch, and per horse $280 \times 60 = 16800$ cubic feet of steam.

One cubic foot of water converted into steam of an elastic form equal to 40 lb. per square inch, will occupy in the shape of steam about 520 times the original volume, consequently the 16800 cubic feet of steam that will be requisite per hour, will be the produce of $\frac{16800}{520} =$ 32·31 cubic feet of water per hour.

$$32{\cdot}31 \times 62{\cdot}5 = 2020 \text{ lb. avoirdupois.}$$

Suppose 1 lb. of coal to evaporate 8 lb. of water, and Messrs. Parkes and Wicksteed have proved that more can be done, but allowing 8 lb. as a fair proportion, the hourly consumption of coal would be

$$\frac{2020}{8} = 252{\cdot}5 \text{ lb. of coal per hour,}$$

$$\text{and } \frac{252}{60} = 4{\cdot}2 \text{ lb. of coal per hour per horse power.}$$

I am aware that nothing in the above computation has been allowed for leakage by the piston, but with a good and true cylinder, and a well fitted piston, very little steam will pass—and if 5 lb. of coal are allowed instead of 4·2 as above, the difference will more than compensate for any loss of this kind.

The above engine was for a considerable length of time doing only 40 horses work, and her average consumption of coal was 1 hectoliter, or 80 kilogrammes of coal of a medium quality per hour, or 2 kilogrammes per hour, and per horse power—2 kilogrammes = 4·41 lb. avoirdupois.

Should you consider these remarks to be worthy of a place in your very useful Journal, you will much oblige,

Your very humble servant,

London, Jan. 11, 1841. H. H. E.

Important to Builders and others.—It may not be generally known that an Act of last Session imposed certain restrictions on the mode of building chimneys, with the view of rendering climbing boys unnecessary in cleansing flues. It is thereby enacted that after the passing of the Act, "all partitions between any chimney or flue shall be of brick or stone, and at least equal to half a brick in thickness," such partition to be of sound materials, "and the joints of the work well filled in with good mortar or cement, and rendered or stuccoed within;" "that such chimney or flue in any wall, not being a circular chimney or flue 12 inches in diameter, shall be in every section of the same not less than 14 inches by 9 inches." The angle at which it is lawful to build any chimney is also determined. Another clause enacts "that from and after the first day of July, in the year 1842, any person who shall compel or knowingly allow any child, or young person under the age of twenty-one years, to ascend or descend a chimney, or enter a flue, for the purpose of sweeping, cleansing, or coring the same, or for extinguishing fire therein, shall be liable to a penalty, not more than ten pounds, or less than five pounds."

LIVERPOOL DOCKS.

Sir—I beg to forward the annexed extract from the "Liverpool Standard" newspaper for insertion in your valuable Journal. My reasons for so doing are:

1st. From personal respect to the talented engineer whose name it bears.

2nd. That the very important document may be preserved, and read by the greatest possible number of individuals at all interested in similar matters. Such documents are very scarce, and very probably this would not have existed, but for the *very extraordinary circumstances* which *demanded* such in defence.

3rd. As a beacon to others, shewing the necessity of always being prepared for similar attacks.

And lastly. To just drop a hint to all the eminent engineers, whether British or Foreign, who may have examined the important works at the Liverpool Docks—works which have been "designed and constructed by the energies of his (Mr. Hartley's) own mind alone, unaided by the designs, arrangement, or superintendance of any other civil engineer." I say just a hint to such persons, that they may lose no time in committing their opinion of the works in question to paper, and forward them to you for insertion in your Journal.

When little dogs bark, it is best to walk away and heed them not; but when great dogs bark and shew their teeth, (especially when they want a bone with a little flesh on it to pick,) there is great danger of their biting; then is the time for defence.

Your insertion of the above, together with the annexed defence, will oblige

Your obedient servant,
A Lover of Fair Play.

Warrington,
1st Jany., 1841.

"To the Chairman and Members of the Dock Committee.

"Gentlemen,—I feel called upon, not only as a mark of respect to those various gentlemen who have composed the Dock Committee during the sixteen years I have had the honour to fill the situation of Dock Surveyor, but also in justification of myself, to make some remarks on the notice of a motion given by Mr. Chapman, at the last meeting of this Committee, as well as to the charges brought against me by him in so abundant and unqualified a manner, both previous and subsequent to his giving notice of that motion.

"It was, I believe, and I do not wonder at it, a subject of surprise to many, that I did not say more in my defence. It was not, however, from a deficiency of matter, but from an overpowering feeling of astonishment at the sudden and unqualified torrent of assertions, charging me with incompetency, incorrect statements, &c., with which I was assailed.

"Had I only to reply to the individual member who made these charges, I might think it proper to take a different course, and should probably simply refer him to the books and resolutions of this committee; but as his charges reflect not only upon me, but upon this committee, upon those who composed the committee before you, as well as upon those who elected me to the office I hold, I think I am bound to rebut them, in doing which I anticipate little difficulty.

"In the first place, I am charged with incompetency and ignorance of my profession, upon which is founded the motion, 'That a first-rate engineer be appointed, to furnish designs for new works, and superintend their construction.'

"In answer to this charge, I will not refer you to the testimonials which procured my appointment to this situation from amongst numerous candidates, without my having had any previous knowledge of any gentleman forming the then council; but I will refer you to those important works which I have constructed since I have filled the situation I hold, from my practical knowledge as a civil engineer, and from the energies of my own mind alone, unaided by the designs, arrangement, or superintendence of any other civil engineer, and which, I may be allowed to say, so far from being considered evidences of *incompetency*, have elicited the admiration of civil engineers of the highest standing, both of our own and foreign nations. I will also refer you to the proceedings of the Dock Committee since my appointment, and during the progress of those works, and I will ask the member who has brought forward these charges, whether he has found in those proceedings (which, of course, he made himself master of before bringing such charges) any resolutions accusing me, in the most remote manner, with incompetency, or casting the slightest stain upon my character? and I will ask him further, to mention an instance in which those interested in the working of the different designs I have furnished and executed, have made a complaint of the inefficiency of those designs, or of their construction, to this committee, until his becoming a member of it, and bringing forward objections against a work, the first of the kind yet executed here or elsewhere, which had been in progress for several months, which had received the approbation of the authority next to be consulted by me after the committee (I allude to the Master of the Graving Docks), and in which, on the 31st July, when partly completed, one of the large steam ships was docked, shored, and the necessary work effected, without a complaint having been made, or an objection offered?—a practical proof of its *not being unsafe for life or property*.

"With reference to the several assertions made by the member concerning this graving dock, which have gone through the newspapers before the public—'That if the large steam-boats, for which this dock was expressly constructed, went into it, their paddle-boxes rested on the quays, and their keels did not touch the blocks by 14 inches,' and also, 'that the sill had been broken up'—I would beg, in the first place, to observe, that the extreme width of the largest steam-ship that has yet come to this port (the President), is, according to the dimensions furnished me, 66 feet 8 inches from outside to outside of paddle-boxes,—whereas the width of the graving dock, from the edge of one quay to that of the other, is 71 feet 6 inches, which proves that the paddle-boxes *could not touch the quay by 2 feet 5 inches on each side*, and secondly, that the *sill* of the dock *has not been altered*. The alterations alluded to by the member, which caused the taking up of the masonry, was an improvement in the original design, but no error, and was totally unconnected with the sill, and partly composed of the original masonry of the former graving dock which had not previously been touched.

"From the blame of having neglected to procure the dimensions of the largest steamers until the work was so far advanced, I think the chairman of this committee can fully exculpate me. With regard to the allusions made by the member, to the south graving docks and Coburg Dock, I have to observe that those matters have been previously canvassed,—but it may be as well to state here, for the information of all, that what the member blames me for, concerning the south graving dock , is what was expressly contemplated in their construction, viz., the increased depth of their silts, to admit of the admission of the heaviest ships coming to the port, at a lower tide than the old graving docks would permit; but if vessels are allowed to be taken in by the carpenters at all tides, it cannot be expected, by any who have paid attention to the tides here, that a sill lying 2 feet 6 inches below the level of the old dock sill, can be laid dry at a low neap tide, which does not ebb within a foot of the level of that datum, unless recourse be had to mechanical assistance. And as to my desire to put reverse gates to the passage leading into the Coburg Dock, that was *an addition to*, but certainly not an alteration of, or error in, my original design; neither did I report 'that the dock was complete, after which it was found that it required deepening,' as asserted by the member, my report to the committee being as follows:—'The Coburg Dock has been completed, *excepting a portion of its bed, which is not yet sufficiently deepened*, but is expected to be all finished in September, chiefly with dredging machines,' and that report would have been borne out, had it not been from the desire to afford the earliest accommodation to the large steamers which have since almost continually occupied the dock, often greatly to the hindrance of the dredging machines.

"I will also beg leave to mention, that so far from my having been considered incompetent by others, I have at various times been requested to exercise my profession in similar and other works, both here and in several other parts of the kingdom; and I may also remark, in noticing the second portion of this motion, that although the terms of my appointment gave me full liberty to exercise my profession elsewhere, yet so closely have I devoted my time to the dock works, as not to allow myself any leisure to accept other engagements, excepting such as my son's assistance enabled me to do, without requiring any lengthened absence from the duties of my situation; and I would wish the member to name any instance in which I have heretofore been accused of non-attendance to, or neglect of those duties; indeed, so far has the contrary been the case, that during the last three years I have not been in the whole more than 15 days absent on private business, and the most of those days I have been but partially absent. In concluding my notice of these charges, I would beg leave to call to your remembrance the circumstance of my having been presented with the freedom of this town *as a mark of the Council's approbation of my conduct as Dock Surveyor*.

"The other charges made against me by the member, and the implication contained in the first part of the motion given notice of, backed as it was by many assertions of impropriety in the expenditure of my department, need not, I think, require any lengthened refutation. With regard to the first of these, personal attacks of this description are easily made on any one filling a public situation, and however unjust they may be, cause great annoyance to those unfortunately subjected to them. In the present case the effect ceases there. I have been too long a public servant here and elsewhere, too long open to the scrutiny of all, to feel afraid of my character suffering from any assertion or observation the member can or has made; and I shall content myself with simply assuring this committee, that in all my statements to them I have invariably adhered to what I have believed to be the truth.

"As respects that part of the motion, stating an increased vigilance in the superintendence of the expenditure in my department to be necessary, taken in the abstract, I have nothing to say against it; on the contrary, too great a vigilance cannot be had to please me, as it will consequently, in like proportion, relieve me from care and responsibility. But taking this part of the motion in the spirit in which it is brought forward, and coupling it with the personal allusions made in bringing it before you, I should have considered it the most serious part of the attack upon me, and should have felt great anxiety to have disproved it most fully, had it been made by any gentleman of experience in the proceedings of the Dock Committee; but when I recollect that it is made by a member who has but recently joined the committee, and who has not yet given himself any opportunity of inquiring into the manner in which the expenditure he alludes to, in my department, is made, never having yet been to my office to ask any explanation or information as to our accounts or method of business, I think it best to refer it to your own judgment, what foundation he has for his assertion, 'that at least a saving of £10,000 a year may be made in my department, *by a different method of carrying on the work*.' I feel, therefore, very easy in leaving my character in your hands, to most of whom I have been known so long, and under whom, until now, I have filled my situation free from all ungenerous attacks or uncourteous treatment. In concluding, I beg leave to quote the following extract from the printed copy of the Inquiry into the affairs of the Corporation of Liverpool, before the Parliamentary Commissioners—'Twelfth day. Mr. Alderman Lawrence said, he was glad to find it was not considered necessary to put any questions to Mr. Hartley, the Dock Surveyor; as an expenditure of £1,400,000 or £1,500,000 had passed through that gentleman's hands, he deemed that circumstance highly complimentary. Mr. Duncan said, he did not know a more deserving officer than Mr. Hartley; the rate-payers were perfectly satisfied with him,' &c.—and to remark, that that opinion, unqualified, uncontradicted, and expressed at such a time, is not exactly in accordance with the member's statement, 'That you will find you have spent as much money in rectifying my errors as the docks themselves have cost.'

"Finally, I take the liberty of calling your attention to a resolution of the Dock Committee of the 31st October, 1836, come to on the reading of my report to them of the 25th of the same month, and to that report I would beg especially to refer the member bringing forward the motion:—

"At a meeting of the Dock Committee, 31st Oct., 1836, present, Charles Lawrence, Esq., chairman, &c. &c., a printed copy of the Surveyor's report having been laid upon the table, in compliance with the directions of the last committee—

"'*Resolved*,—That the committee have read with much satisfaction the able report of the Surveyor upon the state of the works, and regret that, from the shortness of the time since which this report has been delivered, they are not able to enter into any minute investigation of its various details. They feel it quite unnecessary to express any encomium upon those magnificent works which will speak for themselves, and remain a lasting memorial of the great talents of Mr. Hartley. The major part of this committee being about to be removed by an act of the legislature, cannot relinquish their trust without availing themselves of their last meeting to record their high sense of the indefatigable zeal and great ability with which that gentleman has for more than twelve years executed the very important duties of his office, and they beg him to accept their sincere acknowledgments and thanks.

"'Extracted from the proceedings.

(Signed) "'Charles Lawrence, Chairman.'

"Having thus disposed of such of the charges and assertions made by the member as I think it necessary to notice, I feel that it would be an act of injustice to this committee to court a stricter investigation of the various details of my department than they have already received; and the unimportance of the charges which have been made ought, I imagine, to have been a sufficient protection against such an attack as I have been subjected to. If not, the further defence must rest with the committee, not with me.

"It now only remains for me most respectfully to request this committee to do me the justice of calling upon the member to prove his assertions, so serious in their nature, and to hope that this defence may meet with the same publicity as was given to the charges against me.

"I have the honour to be, gentlemen,

Dockyard, Liverpool, Jesse Hartley, Dock Surveyor.
10th Dec., 1840."

RAILWAY COMMUNICATION WITH SCOTLAND.

Third Report of Lieutenant-Colonel Sir Frederick Smith, of the Royal Engineers, and Professor Barlow, to the Treasury, in pursuance of the Addresses of the House of Commons of the 14th and 20th August, 1839.

Railway Committee Office, James-street. Buckingham-gate, 14th Nov. 1840.

Sir—The report which, in obedience to the instructions of the Lords Commissioners of the Treasury, dated the 26th of November, 1839, we had the honour to transmit to you on the 16th May last, respecting the competing lines for a railway communication between London and Glasgow, contains a distinct expression of our opinion, that of the three projects which had been submitted to us for that portion of the distance which extends from Lancaster to Carlisle, the preference was due to the project brought forward by Mr. Larmer, for a railway up the valley of the Lune, and by Orton and Penrith.

We, however, observed that this line would not extend to the district of Kendal the benefits of railway communication; and being aware that this thriving town would not only afford great support to any railway passing near it, but at the same time derive important advantages from such a mode of transit, we had directed the attention of the surveyors to this subject, and suggested the expediency of fresh surveys being made, in order to ascertain the practicability of uniting Mr. Larmer's project by the valley of the Lune with that of Mr. Bintley by the valley of the Kent, so as to carry the line within a short distance of the town of Kendal.

It appears that nearly at the period when our report on these northern lines was forwarded to you, some gentlemen connected with Kendal, and who are very desirous of carrying a railway near to that town, employed Mr Larmer to re-survey the valleys of the Lune and Kent, and to examine the ground which separates these rivers to the north of Kendal. The result is, that this gentleman has considerably modified and improved that part of Mr. Bintley's line which is to the south of Kendal; he has also made some slight alterations in that part of his own line lying between Orton and Low Borrowbridge; and he has laid before us a plan and section for a line to be formed through the pass which intervenes between the Grayrig Fell and the Lambrig Fell, and connects the valleys of the Lune and Kent.

Mr. Larmer terms this new line the "Grayrig Junction," and, for the sake of distinction, we shall give the title of the "Grayrig Line" to the whole project on which we are now about to report, pursuant to the instructions we had the honour to receive from you, dated the 29th May last.

The two principal points which we have kept in view in this investigation are, to determine how the construction of the railway, according to this combined project, would affect the traveller between London and Carlisle; and secondly, whether it would entail an increase of expense more than commensurate with the advantages to be derived from the line passing the town of Kendal.

In our last report, we stated that the locomotive power requisite to work the Lune line, expressed in horizontal distance, would be 78 miles and one chain; and we find, that by the Grayrig line it would be 78 miles and 62 chains.

This increase of 61 chains is not sufficient to form an important objection to the Grayrig project, as regards the traveller between London and Carlisle.

In the appendix (A) we have given a copy of a comparative estimate, submitted to us by Mr. Larmer, of the probable cost of the Lune line, and the Grayrig line.

As we are not in possession of cross sections of the ground where the heavy cuttings and embankments would be formed, nor of borings where the former would be necessary, and as we have also not been supplied with drawings of the bridges, viaducts, &c., it is not in our power to pledge ourselves to the positive accuracy of these estimates; but we think the details given are sufficiently correct to test the relative cost of the two projects; and there does not appear to be any reason for doubting Mr. Larmer's statement, that the Grayrig project would not require a capital of more than £126,219, 7*s*., beyond what would be necessary for that of the valley of the Lune.

In our former report on the lines between Lancaster and Carlisle, in estimating the population within ten miles of each route, the population of Kendal was considered as belonging both to the line of the Kent and to that of the Lune; and, according to this arrangement, the former was stated to be likely to afford railway accommodation to a population one-tenth larger than would derive this advantage from the latter.

The Grayrig line would accommodate a still larger number of persons than the original line of the Kent, as it would include the greater part of the population which gave the latter, under this head of comparison, the superiority over the original Lune line, and in addition would include the inhabitants of Ravenstonedale, Kirkby, Stephen, Brough and Appleby, to which the original Kendal line had no title. Thus the Grayrig line will have a decided superiority over the line of the Lune on the score of population, and therefore the traffic on the former, on this account alone, might reasonably be expected to be greater than on either of the other lines; but when it is considered that a line to Kendal would bring the lake tourists to within eight miles of Windermere, it may be fairly presumed that the number of passengers on this line would be much greater than on its competitors.

Kendal, as a commercial and manufacturing town, is of great importance in the county of Westmoreland, and there is no doubt that on the formation of a railway by the Grayrig Line, the supply of coal for the Kendal district would be almost exclusively derived from Carlisle; indeed it has been shown to us that a revenue of £10,000 a year may be expected from the carriage of coal alone.

In considering the relative merits of the three projects, we find that the Lune line has a small addition over the other lines in regard to saving of distance and economy of construction, but it has the defect of depriving the important town of Kendal of direct railway communication, and embraces a smaller population.

The great objection to Mr. Bintley's line was a summit tunnel of an almost impracticable character.

The line now proposed possesses the principal advantages, and is free from the chief defects of the other projects, and we therefore recommend it in preference to either.

We shall now proceed to give a general description of the line which we thus recommend for adoption.

In our report of the 16th of May, it was stated that Mr. Bintley proposed to form a junction with the Preston and Lancaster Railway, at a point about two miles and 54 chains south of the terminus at the latter place, and to pass under the town of Lancaster by a tunnel.

Mr. Larmer in commencing at the Lancaster terminus, very materially improves this line, as he thereby saves two miles, and 54 chains of construction, and avoids the inconvenience and expense of a separate station; and by keeping to the east of the line proposed by Mr. Bintley, he is enabled to dispense with the tunnel under the town of Lancaster, which was a great defect in Mr. Bintley's project.

The following table exhibits the gradients on the two lines up to Kendal, from which it will appear that the line as revised by Mr. Larmer is in that respect superior to the original line of Mr. Bintley.

Mr. Bintley's Original Line.

Miles.	Chains.			
1	16½	fall	1 in 133	REMARKS.—Commencing at the distance of 2 miles and 54 chains south of the London terminus.
1	54	..	1 in 221	
1	79½	rise	1 in 585	
1	35½	fall	1 in 263	
1	32	rise	1 in 389	
—	54	level		
—	75	fall	1 in 261	
2	17½	rise	1 in 140	
3	42	level		
—	10½	fall	1 in 206	
3	75½	rise	1 in 181	
2	72	..	1 in 153	
22	34			

Mr. Larmer's improvement of Mr. Bintley's Line.

Miles.	Chains.			
1	35	fall	1 in 200	REMARKS.—Commencing at the Lancaster station.
3	62	..	1 in 660	
2	50	level		
2	7	rise	1 in 160	
4	16	level		
1	76	rise	1 in 170	
3	—	..	1 in 160	
1	23	..	1 in 150	
20	29			

Although the gradients are in a slight degree more favourable according to the line as altered by Mr. Larmer, yet the cost of the earthwork will be rather greater, and Mr. Larmer will require a more expensive bridge for the crossing of the Lune, for its length will be about 600 yards, and its height 60 feet; whereas the bridge proposed by Mr. Bintley would not be above one-fourth of the length and one-half of the height of Mr. Larmer's.

However, this difference will be much more than compensated by the saving of the tunnel under the town of Leicester, and by the shortening of the line.

The deviations from Mr. Bintley's line, proposed by Mr. Larmer, are not of sufficient importance to require to be particularly mentioned here.

The direction of the line recommended is shown on the accompanying plan, by which it will be seen that it is intended to pass along the face of the high ground about a mile eastward of Kendal.

Mr. Larmer's junction line commences at a hamlet to the north of Kendal, called Scalthwaiterigg Stocks, whence it takes a north-easterly course, twice crossing the turnpike-road to the northward of Docker Garths and Mosedale Hall; it then proceeds nearly in an easterly course to the farm at Shaw-end. This point is the summit of the junction portion of the line, and is 562 feet above the level of the sea at low water at Lancaster, or 446 feet above the point of connection with the Preston and Lancaster Railway, the distance being 26¾ miles. Here a cutting will be requisite of two miles in length, in gravel and rock, and of the extreme depth of 52 feet, and of the mean depth of 35. This is the heaviest piece of work on the junction line.

From Shaw End the line tends more to the northward, and curving round the foot of some high ground, approaches the bank of the Lune near Dillicar Park, and converges towards Mr. Larmer's original line, which runs almost parallel to the river, up to Low Borrow Bridge.

Althouth the direction of Mr. Larmer's original and improved lines is nearly the same, yet such are the abrupt and precipitous forms of the hills that a considerable difference exists in the levels and gradients.

We subjoin a table of distances and gradients of the entire Grayrig line, and we have only further to remark, that, after an examination of the ground, we have thought it proper to suggest to Mr. Larmer the expediency of occasional breaks in his long gradients, for the purpose of easing the engine on the ascending planes, and of diminishing the earthwork in construction.

We do not consider it necessary to give minute details of the proposed line, as in the annexed copy of Mr. Larmer's report all the most important features of this project are fairly shown.

The heaviest work on the whole line is the Orton tunnel, which Mr. Larmer proposes to make of the length of one mile and 22 chains; but according to the section, in the accuracy of which we have full confidence, it appears that there will be heavy cuttings at both ends of the tunnel, the greatest depth being at one end 95, and at the other 98 feet.*

Now as we doubt the expediency of making a cutting in this instance of above 70 feet in depth, we are of opinion that it would be proper to extend the length of the tunnel to a mile and a half.

*The line of the tunnel in Mr. Larmer's original project was very accurately surveyed by Lieut. H. D. Fanshawe, of the 12th Foot, who reported that the ground was fairly delineated in Mr. Larmer's section.

Table of Gradients of Grayrig Line between Lancaster and Carlisle.

Names of Places.	Intermediate distance.		Total distance.			Feet per mile.	Ratio.
Lancaster........	1	35	1	35	fall	26⅓	1 in 200
	3	62	5	17	fall	8	1 in 660
	2	50	7	67	level		
	2	7	9	74	rise	33	1 in 160
	4	16	14	10	level		
	1	76	16	6	rise	31	1 in 170
	3		19	6	rise	33	1 in 160
Kendal..........	7	45	26	51	rise	35	1 in 150
	2	65	29	6	level		
	2	74	32	30	rise	13⅓	1 in 400
	4	22	36	52	rise	35	1 in 150
Orton Tunnel	1	22	37	74	level		
	3	66	41	60	fall	35	1 in 150
	1	64	43	44	level		
	1	47	45	11	fall	17	1 in 310
	4	1	49	12	fall	26⅓	1 in 200
	1	69	51	1	fall	17	1 in 300
	1	55	52	56	rise	5	1 in 1056
Penrith	1	69	54	45	rise	3½	1 in 1650
	2	53	57	18	fall	21	1 in 251
	1	25	58	43	level		
	5	54	64	17	fall	25	1 in 210
Carlisle.........	6	—	70	17	fall	33	1 in 160

Mr. Larmer acquaints us that, on a careful examination of the Orton Hill, he has every reason to believe that the tunnel would pass entirely through sandstone; and as it would only be 340 feet below the summit of the hill, we have no doubt that this work might easily be completed in three years from the time of its commencement, under the supposition that Mr. Larmer has rightly informed us as to the nature of the rock through which the tunnel is to be formed.

We have the honour to be, Sir,

Your most obedient servants,

FREDERIC SMITH, Lieut.-Col. R.E.

PETER BARLOW, F.R.S.

HENRY AMSINOK, Lieut. R.N., Sec.

Robert Gordon, Esq., M.P., &c. &c. &c.

MEMOIRS OF SCIENTIFIC MEN.

The two following Memoirs are from the Address of the President delivered at the last Anniversary Meeting of the Royal Society.

JAMES PRINSEP, whose brilliant career of research and discovery has been closed by a premature death in the flower of his age, was Principal Assay Master, first of the Mint at Benares, and secondly of that of Calcutta, where he succeeded Prof. Wilson in 1833; he was a young man of great energy of character, of the most indefatigable industry, and of very extraordinary accomplishments; he was an excellent assayist and analytical chemist, and well acquainted with almost every department of physical science; a draughtsman, an engraver, an architect, and an engineer; a good oriental scholar, and one of the most profound and learned oriental medallists of his age. In 1828 he communicated to the Royal Society a paper "On the Measurement of High Temperatures," in which he described, amongst other ingenious contrivances for ascertaining the order, though not the degree, of high temperatures, an air thermometer applicable for this purpose, and determined by means of it, probably much more accurately than heretofore, the temperature at which silver enters into fusion. His activity whilst resident at Benares has more the air of romance than reality. He designed and built a mint, and other edifices; he repaired the minarets of the great mosque of Aurengzebe, which threatened destruction to the neighbouring houses; he drained the city, and made a statistical survey of it, and illustrated by his own beautiful drawings and lithographs, the most remarkable objects which the city and its neighbourhood contains; he made a series of experimental researches on the depression of the wet-bulb hygrometer; he determined, from his own experiments, the values of the principal coins of the East, and formed tables of Indian metrology and numismatics, and of the chronology of the Indian systems, and of the genealogies of Indian dynasties, which possess the highest authority and value. When transferred to Calcutta, he became the projector and editor of the "Journal of the Asiatic Society of Bengal," a very voluminous publication, to which he contributed more than one hundred articles on a vast variety of subjects, but more particularly on Indian coins and Indian palæography. He first succeeded in deciphering the legends which appear on the reverses of the Greek Bactrian coins, on the ancient coins of Surat, and on those of the Hindoo princes of Lahore and their Mahomedan successors, and formed alphabets of them, by which they can now be readily perused. He traced the varieties of the Devanagari alphabet of Sanscrit on the temples and columns of Upper India to a date anterior to the third century before Christ, and was enabled to read on the rocks of Cuttock and Guzeret the names of Antiochus and Ptolemy, and the record of the intercourse of an Indian monarch with the neighbouring princes of Persia and Egypt: he ascertained that, at the period of Alexander's conquests, India was under the sway of Boudhist sovereigns and Boudhist institutions, and that the earliest monarchs of India are not associated with a Brahminical creed or dynasty. These discoveries, which throw a perfectly new and unexpected light upon Indian history and chronology, and which furnish, in fact, a satisfactory outline of the history of India, from the invasion of Alexander to that of Mohammed Ghori, a period of fifteen centuries, are only second in interest and importance, and we may add likewise in difficulty, to those of Champollion with respect to the succession of dynasties in ancient Egypt. These severe and incessant labours, in the enervating climate of India, though borne for many years with little apparent inconvenience or effect, finally undermined his constitution; and he was at last compelled to relinquish all his occupations, and to seek for the restoration of his health in rest and a change of scene. He arrived in England on the 9th of January last; but the powers both of his body and his mind seem to have been altogether worn out and exhausted; and after lingering for a few months, he died on the 22nd of April last, in the 41st year of his age. The cause of literature and archæology in the East could not have sustained a severer loss.

SIMON DENIS POISSON, one of the most illustrious men of science that Europe has produced, was born at Pithiviers on the 21st of June, 1781, of very humble parentage, and was placed, at the age of fourteen, under the care of his uncle, M. L'Enfant, surgeon, at Fontainebleau, with a view to the study of his profession. It was at the central school of this place that he was introduced to the notice of M. Billy, a mathematician of some eminence, who speedily discovered and fostered his extraordinay capacity for mathematical studies. In 1793 he was elected a pupil of the Ecole Polytechnique, which was then at the summit of its reputation, counting amongst its professors Laplace, Lagrange, Fourier, Monge, Prony, Berthollet, Fourcroy, Vauquelin, Guyton Morveau, and Chaptal. The progress which he made at this celebrated school surpassed the most sanguine expectations of his kind patron, M. Billy, and secured him the steady friendship and support of the most distinguished of his teachers. In the year 1800, he presented to the Institute a memoir, "Sur le nombre d'intégrales complètes dont les équations aux différences finies sont susceptibles," which cleared up a very difficult and obscure point of analysis. It was printed, on the recommendation of Laplace and Lagrange, in the *Mémoires des Savans Etrangers*, an unexampled honour to be conferred on so young a man. Stimulated by its first success, we find him presenting a succession of memoirs to the Institute on the most important points of analysis, and rapidly assuming the rank of one of the first geometers of his age. He was successively made Répétiteur ann then Professor of the Polytechnic School, Professor at the Collège de France and the Faculté des Sciences, Member of the Bureau des Longitudes, and finally, in 1812, Member of the Institute. His celebrated memoir on the *invariability* of the major axes of the planetary orbits, which received the emphatic approbation of Laplace, and secured him, throughout his life, the zealous patronage of that great philosopher, was presented to the Institute in the year 1808. Laplace had shown that the periodicity of the changes of the other elements, such as the eccentricity and inclination, depends on the periodicy of the changes of the major axis—a condition, therefore, which constitutes the true basis of the proof of the stability and permanence of the system of the universe. Lagrange had considered this great problem in the Berlin Memoirs for 1776, and had shown that, by neglecting certain quantities which might possibly modify the result, the expression for the major axis involved periodical inequalities only, and that they were consequently incapable of indefinite increase or diminution. It was reserved to Poisson to demonstrate *à priori* that the non-periodic terms of the order which he considered would mutually destroy each other—a most important conclusion, which removed the principal objection that existed to the validity of the demonstration of Lagrange. This brilliant success of Poisson in one of the most difficult problems of physical astronomy, would appear to have influenced him in devoting himself thenceforward almost exclusively to the application of mathematics to physical science; and the vast number of memoirs and works (amounting to more than 300 in number) which he published during the last thirty years of his life, made this department of mathematical science, and more particularly whatever related to the action of molecular forces, pre-eminently his own. They comprehend the theory of waves and of the vibrations of elastic substances, the laws of the distribution of electricity and magnetism, the propagation of heat, the theory of capillary attraction, the attraction of spheroids, the local magnetic attraction of ships, important problems on chance, and a multitude of other subjects. His well-known treatise on mechanics is incomparably superior to every similar publication in the clear and decided exposition of principles and methods, and in the happy and luminous combination of the most general theories with their particular and most instructive applications. Poisson was not a philosopher who courted the credit of propounding original views which did not arise naturally out of the immediate subjects of his researches; and he was more disposed to extend and perfect the application of known methods of analysis to important physical problems, than to indulge in speculations on the invention or transformation of formulæ, which, however new and elegant, appeared to give him no obvious increase of mathematical power in the prosecution of his inquiries. His delight was to grapple with difficulties which had embarrassed the greatest of his predecessors, and to bring to bear upon them those vast resources of analysis, and those clear views of mechanical and physical principles in their most refined and difficult applications, which have secured him the most brilliant triumphs in nearly every department of physical science. The confidence which he was accustomed to feel in the results of his analysis—the natural result of his own clear perception of the necessary dependence of the several steps by which they were deduced—led him sometimes to accept conclusions of a somewhat startling character: such were his views of the constitution and finite extent of the earth's atmosphere, which some distinguished philosophers have ventured to defend. It is not in mathematical reasonings only that we are sometimes disposed to forget that the conclusions which we make general are not dependent upon our assumed premises alone, but are modified by concurrent or collateral causes, which neither our analysis nor our reasonings are competent to comprehend. The habits of life of this great mathematician were of the most simple and laborious kind; though he never missed a meeting of the Institute, or a lecture, or an examination, or any other public engagement, yet on all other occasions, at least in his later years, he denied access to all visitors, and remained in his study from an early hour in the morning until six o'clock at night, when he joined his family at dinner, and spent the evening in social converse, or in amusements of the lightest and least absorbing character, carefully avoiding every topic which might recall the severity of his morning occupations. The wear and tear, however, of a life devoted to such constant study, and the total neglect of exercise and healthy recreations, finally undermined his naturally vigorous constitution, and in the autumn of 1838 the alarming discovery was made that he was labouring under the fatal disease of water in the chest. The efforts of his physicians contributed for a long time to mitigate the more serious symptoms of his malady; but every relaxation of his sufferings led to the resumption of his labours; and to the earnest remonstrances of his friends, and the entreaties of his family, he was accustomed to reply, that to him *la vie c'était le travail;* nay, he even undertook to conduct the usual examinations of the Ecole Polytechnique, which occupied him for nearly ten hours a day for the greatest part of a month. This last imprudent effort ended in an attack of paralysis, attended by loss of memory and the rapid obscuration of all his faculties; he continued to struggle, amidst alternations of hope and despondency, for a considerable period, and died on the 25th of April last, in the 59th year of his age. Poisson was eminently a deductive philosopher, and one of the most illustrious of his class; his profound knowledge of the labours of his predecessors, his perfect command of analysis, and his extraordinary sagacity and tact in applying it, his clearness and precision in the enunciation of his problems, and the general elegance of form which pervaded his investigations, must long continue to give to his works that classical character, which has hitherto been almost exclusively appropriated to the productions of Lagrange, Laplace, and Euler. If he was inferior to Fourier or to Fresnel in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power: if some of his contemporaries rivalled or surpassed him in particular departments of his own favourite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labours. The last work on which he was engaged was a treatise on the theory of light, with particular reference to the recent researches of Cauchy; nearly two hundred pages of this work are printed, which are altogether confined to generalities, whose applications were destined to form the subject of a second and concluding section: those who are acquainted with the other works of Poisson will be best able to appreciate the irreparable loss which optical science has sustained in the non-completion of such a work from the hands of such a master.

DEVELOPMENT OF ELECTRICITY FROM HIGH PRESSURE STEAM.

ON Saturday, the 19th December, Mr. Condie, manager of Blair Iron Works, Ayrshire, performed this new and interesting phenomenon at the above works, in the presence of Ludovic Houston, Esq., of Johnstone; —— Cunningham, Esq., of Carnbrae Iron Works; Thomas Wingate, Esq., engineer; Springfield, and a number of others, who were all highly satisfied with the accuracy of the accounts given by the public press of similar experiments having been made in the neighbourhood of Newcastle, upon locomotive engine boilers. The experiment made by Mr. Condie was upon the steam issuing from the safety valve of two of the high pressure boilers of the blowing engine, and was simply performed as follows:—

The experimenter placed himself upon an insulated stool (a board resting upon three quart bottles in absence of better,) and having in one hand a long small rod of iron, with four sharpened points, similar to a lightning conductor; this he held in the steam issuing from the safety valve. When the points were held about one foot from the valve, electric sparks were drawn by the bystanders' knuckles from those of the experimenter about half an inch long; but as the pointed rod was raised to about six or eight feet above the valve into the cloud of steam, vivid and pungent sparks were then drawn from one and a half inches long, which, in fact, were nearly as stunning upon the arm as the shocks of a small Leyden phial, producing a good deal of merriment to the astonished workmen who were present, to see fire and feel the shocks from steam, an article they all supposed themselves perfectly familiar with.

In the evening the experiment was resumed, to see the effects in the dark, when they proved the experimenter to be highly charged with electricity. The board on which he stood, not being rounded, each corner had a brush of light two or three inches long, like as many tassels, while every point of his dress and hair became highly luminous upon the persons standing near him. On this trial, sparks were drawn fully two inches long, which required some little courage to engage with, from their shocking propensities.

The experiments were made upon the steam of two boilers, thirty-two feet long by six diameter, first with steam equal to 12 lb. upon the inch, and latterly at 25 lb.—the increase of pressure adding to the effect. However, the experiment was perfectly and satisfactorily performed with the surplus steam issuing from the safety-valve while the engine was going upon trial. Mr. Condie is of opinion that, from such boilers, with a properly constructed prime conductor, of large surface, sparks may be drawn from six to eight inches long, and large jars charged in a few seconds. The wonder was that the experiment succeeded at all, as the apparatus was altogether rude. The floor where the temporary stool stood was covered with dust, shavings, &c., which acted as conductors in stealing away the electricity from the experimenter.—*Ayr Observer.*

PUBLIC WORKS IN PARIS.

The *Moniteur* takes a survey of the principal public buildings in Paris and its immediate vicinity, either terminated during the past year, or the works of which have been much advanced. We gather from it the following particulars:—It appears that the interior of the new buildings added to the Luxemburg would have been entirely finisbed but for the interruptions caused by the political trials that have taken place before the Court of Peers. Several alterations have been made in the gardens, and the whole may now be expected to be speedily terminated. Statues or other decorative objects are to be placed on the pedestals of the Pont de la Concorde, to make it harmonize with the present highly decorated aspect of the Place de la Concorde. Nothing but works of ornamentation now remain to be done at the Madeleine. The paintings by Messrs. Abel de Pujol, Schuetz, and Signol have been uncovered in the interior, and the statues that are intended for the several altars are far advanced. The Abbey of St. Denis will still take two years before all the repairs are completely terminated. During the last year the great circular window in the north transept, and the organ-loft, have been finished. The works in the Palace on the Quai d'Orsay are not yet terminated, but the Court of Accounts is expected to move into that building during the spring. The works for new bureaux at the office of the Minister of the Interior, Rue de Grenelle, are rapidly advancing: as are also those at the hotel of the Minister of Public Works, Rue St. Dominique. The archives of the law department are to be removed from the Sainte Chapelle to the new buildings at the Hôtel de Soubise, Rue du Chaume, preparatory to the restoration of the former edifice. An amphitheatre for lectures has been erected at the Observatory, and several buildings have been made at the Veterinary School of Alfort, for giving better accommodation to the professors for their lecture, &c. The buildings of the new Blind Hospital, Boulevard des Invalides, will shortly be entirely roofed in: and the additional erections at the Lunatic Asylum at Charenton are going on rapidly. Numerous public buildings, such as the Bibliothèque Royale, the Bibliothèque St. Geneviève, and the Conservatoire des Arts et Metiers, are in such a dilapidated state, that the Chambers will no doubt vote the funds requisite for repairing them, or erecting new ones.

NEW INVENTIONS AND IMPROVEMENTS.

PAPYROGRAPHY.

This is a new invention for reproducing drawings, manuscripts, and all kinds of designs to an unlimited extent, and by means much cheaper than at present known. This process, which is called by M. de Manne, the inventor, *Papyrography*, is very fully noticed in a late number of the *Moniteur*, from which we abridge the following particulars.—The mode by which M. de Manne produces designs, &c., on paper, is thus described. After having, by means of his prepared metallic ink, traced the drawing on common writing paper, he contrives, by an operation which he at present keeps secret, to make the lines rise from the paper in relief, and become extremely hard and durable. He fixes this matrix on a plate of metal, on which he then places the paper that is to receive the impression. Over the paper he places a piece of silk, and passes it under the roller of a copper-plate press; when the characters and lines on the manuscript or drawing are reproduced, stamped in on the paper. These designs thus fixed on the plates are hard enough to allow of a greater number of impressions being taken without injury to them. The part of the invention, which consists in obtaining plates of metal cast from the matrix afforded by the drawing on the paper, is considered by the committee of the Society of Arts of Mulhausen, who were appointed to examine it, as of still greater importance than any other. By this engraving on paper, say the committee, may be obtained impressions fully equal to what can be had from wood engravings; by this means, therefore, works which require illustrations may be printed with great cheapness. In engraviags on wood, the design and the subsequent cutting are necessary, but by the papyrographic method, the design is the only expense; and it will produce without end as many engraved plates and impressions as may be required, at a cost one-half of that of the usual processes; and with a precision equal to that of the original drawing.—As M. de Manne conducted his experiments at Rouen, where there was no skilful metal founders, he laboured under great disadvantage in his attempts to bring his invention to perfection, but the specimens he sent to the committee were sufficient to convince them that his plan was capable of answering all that he stated. Some of the specimens sent to the committee presented the designs, and the printed copies from them in relief to the height of from two to three millimetres, obtained solely from the matrix traced on paper. The committee propose to extend the invention to the printing of woven fabrics and paper. M. de Manne sent some plates prepared for this object, but owing to the disadvantages under which he laboured, the plates were not so perfectly cast as they ought to have been, to produce the desired effect. The defect, however, he ascribes entirely to the unskilful manner in which the Rouen founders took the cast of his matrices: for not venturing to trust them with the paper moulds, he took casts of them in plaster; from which the metal plates were afterwards cast. It is to this circumstance that M. de Manne attributes the failure of his experiment, as it was difficult to take the cast in plaster from the paper so as to preserve the sharpness of the outline. He says he is certain of the success of his process as applied to the printing of papers and calicoes, but want of means with him, as with many other inventors, prevents him from taking out patents, or from carrying the invention into operation. The committee report that it seems to them highly probable that if the inventor was placed in more favourable circumstances, he would arrive at remarkable and very useful results. In conclusion they recommend the society to grant him a silver medal, though the invention is not of a nature within their usual subjects for prizes.—*Inventors' Advocate.*

BRICKS AND TILES MADE BY MACHINERY.

The French Academy of Sciences lately appointed a committee to examine a machine for making bricks, invented by M. Carville. The following is the substance of their report.—The committee proceeded to examine the action of the machinery in reference to its three principal functions,—of mixing the materials, of moulding the bricks, and afterwards of extracting them from the moulds. The mixing of the clay is performed in a vertical cylinder, by means of an iron axle, to which arms are fixed at different heights, which are furnished with knives. A rotary motion is given to the axle, by the power of a horse, applied to the end of a long lever. The materials are thrown in at the upper end of the cylinder, and when properly mixed, are passed into the moulds, through an opening in the side towards the bottom. Inclined boards, in the form of the sails of a wind-mill, are connected at the lower end of the vertical axle. The pressure resulting from the inclination of these boards constantly pressing against the clay during their rotatory motion, forces it out of the opening; a small vane, formed of iron plates, regulates and restricts the manner in which it issues out. An endless chain, composed of moulds of cast iron, joined to each other by hinges, passes under the base of the cylinder, and the moulds are thus filled with the prepared clay. A heavy roller, of cast iron, begins the compression; it is finished by drawing the loaded moulds through a compressor, composed of two plates of iron, the surfaces of which are not quite parallel. The removal of the bricks from the moulds takes place immediately after the compression, by means of a rammer acting from above. By causing the rammer, during the process, to move in the same direction as the chain of moulds, a continuous action is obtained, by means of very simple mechanism. The moment when the blow of the rammer should be given is very ingeniously determined, by joints fastened to the moulds. This motion, thus derived from the chain of moulds, and acting invariably with it, prevents the inconveniences that would result from the lengthening of the chain, by the inevitable wearing out of the hinges. The adhesion of the earth to the sides of the moulds, is avoided by their being immersed, for half a revolution of the cylinder, in water, with which a vessel placed under the machine is filled.—Two hoppers are introduced in the machinery, before and after the reservoir, where the earth is prepared. They spread in the requisite quantities the fine sand with which they are constantly supplied. One of them spreads the sand before the moulds are filled, upon plates of iron, connected together so as to form an endless chain, which serves as the bottoms for the moulds. The other hopper sprinkles the surface of the bricks before compression. Thus any adhesion of the substance continues to be avoided both with the roller with which the compression begins, with the iron work which completes it, and with the rammer which removes the clay from the mould. For greater precaution, and in order to obtain more regular surfaces, a slight stream of water continually moistens the pressing roller. The bricks are received on an endless chain of iron plates, after they are taken from the mould, by which they are conveyed to the kiln. The power of a single horse, by turning a wheel, prepares and moulds about 1,500 bricks in an hour.—The commissioners, on concluding their report, observed, that they had convinced themselves of the complete mixture of the substances forming the bricks, by breaking and inspecting several of them. They inspected the whole process, and so far as the result of the manufacture was concerned, they express themselves perfectly satisfied. As to the saving to be effected by it, they had no ground on which to arrive at a satisfactory conclusion, so as to confirm the statement of the inventor, who affirms, that for the cost of two frames he can mould a thousand bricks. From their inspection of the working of the engine, they were enabled to think that this statement is correct.—*Ibid.*

NAIL, PIN, AND RIVET MACHINERY.

William Southwood Stocker, of Birmingham, certain improvements in machinery applicable to making nails, pins, and rivets, Jan. 2. Claim first.—Mode of combining the forging tools in a moveable frame, and causing such tools to approach each other and forge a bar of iron that is properly held by a machine, either in making the stems of nails or bolts, or in pointing their ends. Claim second.—Mode of constructing the heading and cutting machine. Claim third.—Mode of applying moveable dies to the machine, for heading pins and rivets. Claim fourth.—The turning over by machinery and cutting a series of plates or strips of metal in making cut nails. A crank axle is mounted in a strong frame communicating by means of pulleys to the engine. Four iron bars are caused to slide backwards and forwards in a frame by a rod from the crank axle. Other sliding bars are placed so as to move in a position at right angles to these. Their ends are supplied with anti-friction rollers, that work against an inclined plane. By these bars the forging tools are moved to their proper places. A tube extends along the machine, one end of which very nearly approaches the forging tools. A red hot bar of iron is passed through the tube: motion is given to the axle, which, through the connecting rod, gives motion to the sliding bars and rollers, causing the forging tools to close together, and their action on the heated bar produces the shanks of bolts, nails, or rivets, of any shape or size. The heading machines are constructed by a cranked axle, working the heading die, which strikes the bolt as it lies in a proper cavity, and forms the head of the nail or rivet. Another machine is shown in which the working parts are the same, only instead of a fixed cavity for holding the shanks previous to the heading, dies are used, one of which is moveable and the other fixed, and are held together by a spring catch and lever. With reference to the last part of these improvements: a pair of shears are worked by the revolution of a crank axle. At the face of these shears a series of cylinders are placed angularly. Through the end of each a strip of metal of the required width passes. The whole of the cylinders are connected by pinions and a rack, so that on the cranked axle being made to revolve, a nail is cut from each strip of metal by a descending cutter. A sliding motion is then given to the rack, which causes the cylinders and pieces of metal to move round sufficiently at every stroke of the cutter, to preserve the angular or taper form of the nails or brads.—*Ibid.*

SUBMARINE PROPELLERS.

John Edward Carpenter, of Toft Monks, Norfolk, improvements in the application of machinery for assisting vessels in performing certain evolutionr upon the water, especially tacking, veering, propelling, steering, casting or winding, and backing astern, Dec. 12. Claim first.—The application os adaptation of submarine propellers, as hereafter described, in whatever situation such propellers may be placed. Claim second.—The peculiar form of the propellers, shown in the drawings annexed to this specification. These improvements may be divided into three parts:—First—The method in which the propelling apparatus is fixed, for propelling vessels at the greatest possible speed attainable, with reference to submarine rotary propellers on the quarter. Secondly—The method of applying the same apparatus, so as to turn vessels about without the assistance of wind or rudder. Thirdly—The method of applying the apparatus to vessels, with one propeller at the stern. The blades and screws forming the quarter propeller may be constructed either of metal or wood, their strength and superficies depending on the size of the vessel which they will have to propel. Spindles are constructed, which consist of moveable axles protruding through the vessel at both quarters, near the line of floatation, below the load-water line and above the keel, between the midship section and the stern frame. These spindles are enclosed by metallic cylinders, or other proper packing, having a cup and socket valve and stuffing-box at one, or both, ends, and are firmly secured to the timbers of the vessel. That part of the spindle which is within the vessel is to be connected to a steam-engine, or other first mover, by any convenient mechanical contrivance. The outer part is connected to the propelling shaft. The regulator consists of a rod furnished with a rack and pinion, with a pendant bearing attached to the propelling shaft at the bottom of the rod. Through this bearing the propeller shaft passes, by which means the propeller can be raised or lowered, as circumstances may require. The end or stern bearing is constructed of metal and bolted firmly into the transom of the vessel, so as to be capable of resisting the force of heavy seas against the propeller, and also of being easily detached. With reference to the second part of these improvements, a bevelled wheel is fitted upon the capstan, and this communicates the motive power to the propellers; there are two pinions which gear with the bevelled wheel. The axle of the pinions are connected with the spindles as above described. The propeller is confined in its position by a stay and other parts of the apparatus. The shaft rotates in a bearing, and can be raised or lowered by means of a topping lift. After the apparatus has been connected with the capstan, it is only necessary to turn that by power, and the head of the vessel will move round. The third part of this invention consists in the manner in which the rudder is divided, so as to admit the shaft of a single propeller to pass through it, and also in the form of the blades to be applied to such shaft. The length of each blade is more than twice its radius, and two of these blades are placed angularly upon the shaft, which is supported by a hinged bearing at its extremity, a strong iron connecting piece joining the rudder at its upper and lower divisions.—*Ibid.*

PLASTER CASTING.

Plaster of Paris is sulphate of lime, or gypsum, deprived of its water of crystallisation by heat. In this state it has such an affinity for water, and is capable of taking up so much, that when the powder is mixed with water till it becomes of the consistence of cream, it sets after a few seconds into a hard mass. In the manufacture of plaster casts, we must pay attention to several little niceties, in order to get rid of all the air bubbles. These arise from two causes, either from the adhesion of the air to the plaster, or from the plaster carrying down air with it, when added to the water. The first is to be remedied by using fresh burnt plaster, which is always adopted by the cunning stereotypers, for they state that if it simply stands a fortnight, the casts will not be so good. The workman cannot explain this, but the rationale was well known to Mr. Wyatt, our celebrated sculptor, who told me that he attributed it to the adhesion of the air; and that thus many delicate casts were injured. He places the common plaster in a saucepan over the fire, and heats it, when it heaves from the discharge of gas, and is then ready for use. Sufficient plaster should be placed in a basin, and water poured upon it till it is completely covered, and all bubbles cease to rise, when it must be thoroughly mixed by rubbing it together. The surface to which it is to be applied should be slightly brushed over with a very small quantity of salad oil. A little fluid plaster may then be poured on the cast, and with a hog's bristle painting brush thoroughly rubbed into all the fine parts, which will prevent the adhesion of any air bubbles in the plaster which might prevent a perfect impression. Another portion of plaster, sufficient to give the desired thickness is now to be added, and time must be given for the whole to set, when it should be removed from the mould, and gently heated to drive off excess of moisture.—*Smee's Elements of Electro Metallurgy.*

PRESERVATION AND STAINING OF WOOD.

M. Boucherie's process, which we have already noticed, proposes to render wood much more durable, to preserve its elasticity, to prevent it from undergoing variations in volume, to which it is liable by dryness and humidity, to diminish its combustibility, to increase its tenacity and hardness, and to give it varied and durable odours and colours. The mode is, to cut the tree at the bottom when it is growing luxuriantly and full of sap. The lower part is then immersed in a trough containing the liquid which it is intended shall penetrate the vessels of the tree. This will reach the highest leaves in a few days. It is not necessary that the tree should be supplied with all its branches and leaves: a few leaves at the summit will suffice. It is not, however, necessary to cut the tree: a niche at the bottom will answer the same purpose, by which the liquid may be introduced. 1. To increase the *hardness* of the wood, and to preserve it from decay, a solution of pyrolignite of iron is to be employed, a substance readily formed by digesting iron filings in pyroligneous acid. 2. To diminish the combustibility, M. Boucherie introduces chloride of lime, or the mother liquor of salt marshes; the wood is thus rendered more flexible. 3. The author also stains the most common natural and indigenous woods. With pyrolignite of iron, a brown colour is produced; with tannin, an inky colour is formed; Prussian blue and yellow tints are afforded by introducing these substances with prussiate of potash, acetate of lead, and chromate of potash. This paper has been very favourably reported on by Dumas, Arago, &c.

FIRE PROOF BUILDINGS.

Louis Lecomte, of Leicester Square, gentleman, for constructing fire-proof buildings. Jan. 9, 1841. This plan consists in the employment of iron frames to receive concrete matters for forming the walls. The basement story of the building is constructed according to the ordinary methods up to one foot or more above the ground; on the basement so constructed is to be erected the patent wall, formed of frames entirely of cast iron, in one or more pieces, or a combination of cast iron and wrought iron plates. These frames are to be set one on to the other until the required height is obtained, the necessary stability being obtained by means of steady pins at the corners of one frame fitting into holes made in the corners of the frame which is opposed to it. Suitable shaped frames are employed for the internal partition walls, and for doorways, window frames, &c. The flues of the chimneys are formed of iron or other metal pipes, placed in the thickness of the walls. When the required elevation is obtained, a concrete of any suitable materials is poured into the framing, and fills up the vacant space, giving firmness and solidity to the structure; a concrete of gravel and lime is preferred. To give steadiness, lead is to be introduced between the joinings of the iron work, in the manner well understood by workers in iron. The doors and window frames are to be fastened to the walls by any of the usual known methods. The main beams and cross beams of floors and roofs may be of cast iron, or formed of iron and wood; or they may be formed of one or more pieces of plate iron, bent up into an oval form, and straightened by an iron or wooden bar passing through them lengthwise, the upper edges of the metal being turned over to increase the strength. In the interval between the beams there are to be iron rods running in various directions, and supporting a metallic wire work, which forms the foundation of the ceiling. Similar wire work is to be employed in lieu of laths for all plaster surfaces. The claim is —1. The mode of constructing the walls of buildings by applying frames of iron filled with concrete. 2. The mode of constructing beams of bent plates of iron. 3. The mode of forming ceilings and other plaster surfaces by the application of wire work in place of laths.—*Mechanics' Magazine*.—[The last claim was adopted in the building of the Pantechnicon, near Belgrave-square. —Ed. C. E. and A. Journal.]

RAILWAY CONFERENCE.

On Tuesday, 19th ult., a general meeting of railway directors and managers was held by appointment at the large room in the Queen's Hotel, Birmingham, at which were present delegates from the following companies, namely:—Birmingham and Derby, Birmingham and Gloucester, Chester and Birkenhead, Eastern Counties, Great Western, Hull and Selby, Lancaster and Preston, Liverpool and Manchester, London and Croydon, London and Greenwich, London and Birmingham, London and Brighton, London and South-western, Manchester, Bolton, and Bury, Manchester and Leeds, Midland Counties, North Midland, North Union, York and North Midland.— George Carr Glyn, Esq., was called to the Chair, and a lengthened discussion took place upon the objects of the meeting. The following is a copy of the resolutions, which were unanimously adopted:—

1.—That in consequence of the public anxiety occasioned by the accidents which have taken place on various railways, the companies here represented, in order to profit by the combined experience of the principal lines, have deemed it expedient that a general conference should be held, for the purpose of taking into consideration the causes and circumstances of such accidents, and the means that may be available of more effectually guarding against their occurrence for the future.

2.—That this meeting acknowledges the grave responsibility which attaches to railway directors, and the obligation under which they lie, to adopt all judicious and practicable expedients for ensuring the general accommodation, comfort, and safety of the passengers entrusted to their charge. That under a strong impression of this responsibility they have assembled on this occasion, and have pursued their deliberations at the present conference.

3.—That this meeting, while it deeply regrets the accidents which have occurred, looks forward with confidence to the beneficial result of unremitting vigilance and habitual caution steadily enforced and established, as the great means of safety to railway conveyance, and accordingly would deprecate any sudden or hasty legislation on the subject; being convinced that the means referred to, aided by such improved arrangements and mechanical adaptations as a more matured experience may suggest, will amply accomplish the desired object.

4.—That the moral character and general fitness of enginemen and firemen, as well as of policemen and other servants, in the correct performance of whose duties the public safety is involved, are so essential to the security of railway travelling, that this meeting recommends to all railway companies the strictest examination into these points; and that it should be a rule more generally adopted amongst different managements, not to employ servants having worked on other lines, without authentic and satisfactory testimonials from their former employers.

5.—That in case of serious neglect of duty on the part of railway servants, it is desirable more frequently to put in force the penal provisions of Lord Seymour's Act, in order that the strictest discipline may be maintained; at the same time this meeting considers it due to men whose services are so arduous, to encourage the requisite discipline and obedience of orders, by adequate remuneration, and by suitable rewards for extraordinary exertions or long sustained good conduct.

6.—That the directors at this meeting assembled have taken into their serious consideration the expediency of placing on the engine a third man as conductor or captain, in addition to the engineman and fireman usually employed; and they are of opinion that such a measure, by distracting attention, dividing authority, and removing or diminishing the responsibility of the enginemen, would increase rather than lessen the risk of accidents to the trains.

7.—That this meeting considers it desirable that there should be a uniform system of regulations and signals recognised as applicable to all railways; and they recommend that the following rules and regulations, with this view, be submitted to the consideration of each railway company.

The following is the code of signals recommended:

Signals by Night.

The *white light* stationary, indicates that all is right; but if waved *up and down*, is a signal to stop; if waved *to and fro*, sideways, to proceed cautiously.

The *red light* is a signal always to stop.

By Day.

The *red flag* is the signal to stop.

The *blue flag* is to stop second class coach trains, luggage, or picking up trains, for the purpose of sending on wagons.

The *black flag* is used by plate layers to indicate that the road is undergoing repair, and that trains must pass slowly.

It is to be understood that *any* flag or lamp, of whatever colour, *violently waved*, is a signal to stop.

[We think it is a great pity that such a great assembly should have taken place to produce such a trifling result. Parturiunt montes, nascitur ridiculus mus. It does appear to us that the directors might have been better employed, or have brought out a more efficient code. The whole affair is quite in the British Association style.—Editor.]

ROYAL POLYTECHNIC INSTITUTION.

We promised ourselves and our readers, last month, a more extensive account of this valuable institution, which we shall now endeavour to give—although, probably, it will be a work of supererogation, as so many of our readers must be either contributors to it, or visitors. The building itself we have sufficiently described on a former occasion, when we gave a plan and engravings of it, so that it now only remains for us to notice some of the many attractions in the exhibition. Going into the Hall of Manufactures, we find a four-horse power double-cylinder condensing engine, by Humphrys, of Lambeth. Entering the gallery of the Great Hall, we meet with one of the first of a series of artistical exhibitions; here you may have your profile taken, go to another artist, and for a trifling fee he models your likeness, this you may have electrotyped, engraved on copper, or lithographed, all in the same establishment. The assemblage of models of planets, on a scale of an eighth of an inch to a mile, is an epitome of the wonders of creation well calculated to suggest serious meditation; the little globe on which we live is dwindled to the proportions of a child's taw, and yet, to place these planets in their due positions, would take a space of seven miles diameter. Long's engine-turning on glass presents old specimens of a standard favourite. Close along side are some of Crace's works in papier maché. In the case marked B are some truly valuable examples from the factory of Mr. Apsley Pellatt, of the progress we have made in the manufacture of glass. We wish we could particularize some of the well-executed ornaments from the Elgin marbles and other antiques. The chess table, painted on slate, in imitation of various marbles, is a very good proof of the skill of the artist, and of the value of the material as a ground for decoration. In case F are some of Mr. Reid's engines. In a side room is a great variety of vases and other works of art, and objects of utility, from the Royal Swedish Porphyry Works at Elfdal, in Sweden. There is only one objection we see to the general use of this stone, and that is the dearness of the articles, which, although they are of everlasting durability, tells upon the pocket. A little encouragement, however, and the proprietors will find means of reducing their prices. Here we may mention the many fine specimens of stained glass by several artists, and of flower painting by Madam Comolera. Now we have spoken of painting on glass, a reviving art, we must call attention to the specimens of wood carving exhibited, which will serve to show that we only want encouragement to revive this also—one by a boy of 9 (No. 438), is promising. Sir George Cayley, with the intention, probably, of competing with Cinderella's Crispin, has deposited, in case H, a pair of slippers, the uppers (we were going to write upper-leathers) composed of glass—these were doubtless the true Cinderella shoon. Elsewhere are some other good specimens of glass weaving. No. 531, &c., are 72 specimens of earths taken in boring a well 220 feet deep at Colebrook Cottage, Islington, showing the difference of the strata at every foot after the first hundred, which were principally blue clay. Osler's anemometer is an ingenious machine, but we should not think works favourably in its present position, as the registering apparatus must be interfered with by the elasticity of the floor, and the moving about of the company. In the lower part of the Great Hall are a number of engines and models, of which it is next to impossible, in our cramped space, to give any account. We must say the same of those relating to marine engineering. In the North-West Sky-light Room is a splendid mosaic table of Swedish porphyry, consisting of nearly 10,000 pieces, and of great weight; the price asked is, we believe, 3000 guineas. Going behind the Great Hall we get into a labyrinth of darkened passages, from which are views of a number of dioramic subjects, among which we must particularly call attention to the Typorama, or model of the Undercliff, in the Isle of Wight. In the West Balcony Room is the porcelain Table des Marechaux, painted by Isabey; five thousand guineas is asked for it, and it is said to have cost twelve thousand, but we fear it will be long before the raffle is filled. Another gorgeous and costly affair is the escriban or cabinet of Margaret of Parma, in the East Balcony Room. Dispersed about are many fine works of art by Mr. Longbottom, and eminent artists.

The best idea we can give of the Polytechnic Institution, is to call it a bazaar of science; you have a number of separate exhibitions and collections thrown into one, you witness the exercise of several arts, you have the use of two lecture rooms, and from the gallery a band converts the halls into a promenade concert, and this morning and evening:—and so with this epitome we shall leave the Polytechnic and its crowded halls to the occupation of our readers.

ENGINES ON BOARD THE "GORGON" AND "CYCLOPS" STEAM FRIGATES.

Fig. 1.

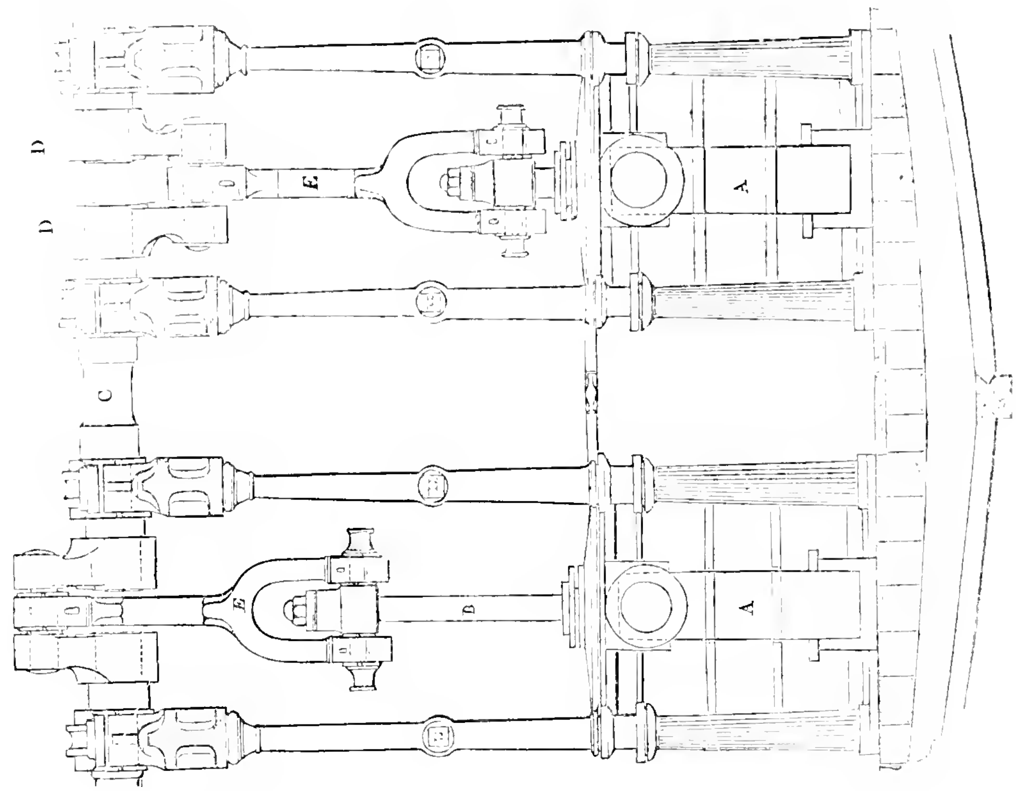
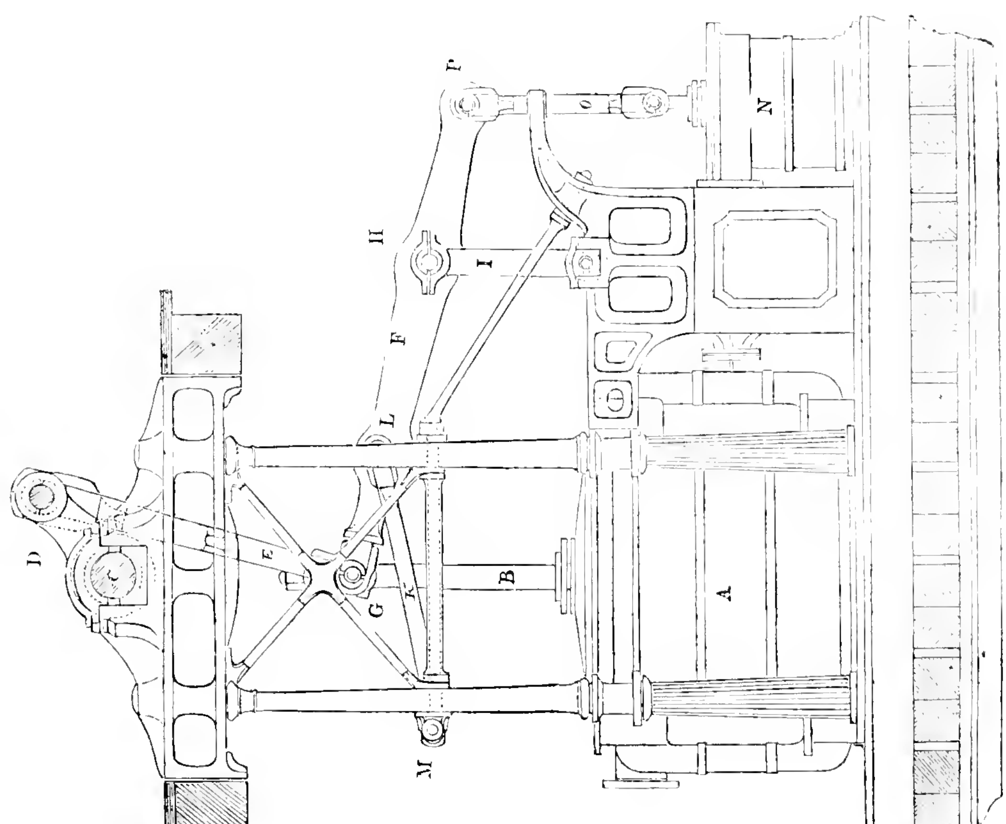


Fig. 2.



DESCRIPTION OF THE ENGINES ON BOARD THE "GORGON" AND "CYCLOPS" STEAM FRIGATES.

For the following description we are indebted to Mr. John Seaward's pamphlet, from which we have already quoted the two excellent papers "On Long and Short Stroke Engines," and "Long and Short Connecting Rods," published in our last volume; and for the engravings we are indebted to the *Mechanic's Magazine*.

The steam engines which have been supplied by Messrs. John and Samuel Seaward and Capel to the British steam frigates *Gorgon* and *Cyclops*, and to several other large Government steamers, are constructed upon a plan differing materially from those which have hitherto been mostly used in steam navigation; they have been denominated "The Gorgon Engines," from the fact of a pair on this plan having been first tried on board the steam frigate of that name.

These engines are constructed on the principle of what is called the "direct action," that is to say, the power of the engines is communicated from the piston by the piston rod, direct to the crank, without the intervention of those side levers or beams, cross heads, fork heads, and side rods, which are usually employed in the construction of marine engines. The engravings, one being a side view, and the other an end view, will give a tolerable idea of the arrangement of these engines:

A is the cylinder; B the piston rod; C the main shaft; D the crank; E the connecting rod, which connects the top of the piston rod to the pin of the crank.

The top of the piston rod is constrained to move up and down in a perfectly straight vertical line, by the aid of a peculiarly constructed parallel motion. The bar or lever F is jointed to the cap of the piston rod at G, and it also turns or oscillates on the joint or bearing H, which joint or bearing is supported by the rocking standard I; the bar or lever F is retained by a pair of rods K, which are jointed at one end L to the bar or lever F, and at the other end to the fixed centre M.

N is the air pump, which is worked by means of the pair of side rods O, which are attached to a prolongation P of the aforesaid bar or lever.

It will be observed that the distinctive features of these engines are, first, the line of shafts being placed directly over the centre of the cylinders; and, second, the power being communicated direct to the crank without the aid of beams, cross heads, side rods, &c., as before stated.

The line of shafts rests upon strong frames, which are supported by wrought iron columns, standing upon the top of the cylinders: so that the whole force of the engines is confined between the cylinders and the supporting frames and columns, and does not act against any part of the vessel.

It should be observed that many engines have been constructed, previous to the Gorgon engines, upon the principle of the "direct action," but the arrangements of all those engines have been widely different.

The advantages of the present system are very considerable, and consist of:—

1st. *A Great Saving of Space.*—A pair of Gorgon engines do not occupy much more than one half the space required for a pair of beam engines of the usual construction.

2nd. *A Great Saving of Weight.*—The weight of a pair of Gorgon engines is 25 per cent. less than that of a pair of beam engines.

3rd. *Greater Exemption from Accident.*—The simplicity of the arrangements, and the reduced number of moving parts, necessarily lessen the chance of accident, as also the wear and tear.

4th. *Greater Security for the Engine-men who work the Engine.*—There being no side levers or beams in movement, the men can move round the engines in every part with perfect safety; but they cannot do so with beam engines without much danger.

5th. *The Tremor and Vibration usually experienced in Steam Vessels are almost entirely prevented.*—The chief cause of the tremor and vibration observable in steam vessels, is the pumping action of the beams or side levers, which causes a great strain and effort throughout the whole vessel; but there is nothing of this in the Gorgon engines.

6th. *A more efficient and economical Application of the Motive Power*,—resulting from the absence of a large mass of moving matter, and of many joints and bearings, the latter of which especially, is in ordinary engines the cause of *much* loss of power.

The advantages above enumerated will, for the most part, be very obvious, on even a slight examination, by any impartial and competent judge; and of the great importance of the advantages themselves, no one will pretend to doubt for a moment. Indeed, as regards the successful application of this system, the matter is now placed beyond all dispute, as the trials of it, made in the *Gorgon*, *Cyclops*, and several other vessels, during the last three years, have been most satisfactory and conclusive.

REVIEWS.

Pambour on Locomotive Engines. London: John Weale, 1840.

(SECOND NOTICE.)—*(Continued from page 16.)*

In the 11th section it is shewn that on Railways with a wide gauge, like the Great Western, the locomotives have the advantage, at moderate velocities, such as 25 miles per hour, of conveying much greater loads, and consuming less fuel per ton per mile, than on railways with a narrow gauge.

The subject of Adhesion is but superficially treated in the 14th chapter. The adhesion of an engine is not correctly measured by the load *it has drawn*, but by the greatest load *it can possibly draw*, without the driving wheels slipping on the rails, and of this we have no determination; the author has contented himself with shewing, from data furnished by experience, that the adhesive force, when the rails are in good condition, is equal to *at least* $\frac{1}{5}$ of the adhering weight, and, when they are greasy and dirty by the effect of wet weather, it is, except in very extraordinary circumstances, *at least* $\frac{1}{27}$ of the adhering weight.

The limit of the adhesion of an engine might however be deduced from the friction which would result if the engine were dragged along on the rails with the wheels fixed.

Chapter XV. treats of the effects of the regulator, and in the 16th the effects of the lead of the slide are discussed at considerable length.

In the 17th chapter the author investigates in a very clear and scientific manner the influence of inclined planes on the velocity and load of locomotive engines, and deduces therefrom rules which may assist in deciding on the best line to be chosen for a railway between two given points. It is here most satisfactorily proved that the work done in conveying a given load from one point to another is less on a level road than on one consisting of alternate ascents and descents, and that the greater the inclination of the planes, the greater is the amount of work done.

The 18th chapter, on Curves, completes the theoretical considerations of locomotive engines on railways; but it is evident that the author has not given this subject an equal share of his attention, for it is not treated with that perspicuity and just application of science, which characterize most of his investigations. In the 2nd section, when treating of curves of which the resistance is corrected by the conical inclination of the tires of the wheels, he says, page 521,

"The calculation of these effects evidently depends on two things: the intensity of the centrifugal force produced by the motion of the wagons in the curve, and the intensity of the centripetal force produced at the same time by the inequality of the wheels of the wagons."

We are assured that, if M. de Pambour had given a little more attention to this point, he would have seen that the tendency of a cone to roll in the circumference of a circle is not due to any force, but simply to the adhesion of its surface to the planes on which it rolls, which prevents one part from slipping while another is rolling, on account of the friction that would ensue. This tendency does not, however, counteract the centrifugal force: it merely corrects the tendency which wheels of equal diameter would have to roll on in a straight line, and which would thus co-operate with the centrifugal force in causing the carriage to run off the rails. If the effect of the centrifugal force is counteracted by the conical form of the tires in traversing a curve, without the flanches of the outer wheels coming in contact with the rail, it must be in consequence of the centre of gravity of the carriage being raised by its lateral displacement.

The Appendix contains a great quantity of useful information concerning the expenses of haulage by locomotive engines on railways, with Extracts from the Report of the Directors of the Liverpool and Manchester Railway, from the opening of the railway, on the 16th September 1830, to the 30th June 1831.

Notwithstanding the exceptions we have taken to some few portions, the chief part of the work will be found highly instructive, and abounding with valuable data; and the practical tables interspersed throughout will be a great assistance in applying the various formulæ.

The Science of Vision, or Natural Perspective, containing the True Language of the Eye, &c. &c. Second Edition, 24 Plates. By ARTHUR PARSEY, M.B.A.A.S. London, 1840.

Most of our readers, we presume, have heard of that kind of discovery which goes by the name of "finding a mare's nest;" and such it appears to us is that discovery in the laws of optics and perspective on which Mr. Parsey so greatly prides himself; and of whose value he tries to convince us at first sight, by exhibiting a practical application of it in his own frontispiece. In one respect, indeed, that illustration has no novelty, for in nearly every work on perspective we are acquainted with, the subjects introduced as examples, are for the greater part either the most insipid or the ugliest things imaginable, nor does that piece of architecture,—which, by the by, was exhibited a season or two back at the Royal Academy, where it met with a good deal of quizzing,—form any exception to such general rule. It says so little for our discoverer's knowledge of, or taste in, architecture, that he would have acted more discreetly, had he contented himself with *Parseyfying* some building already provided to his hand; nor could he, perhaps, have selected a better subject to operate upon than the front of the Soanean Museum, that being a tolerably whimsical specimen of architecture in itself, and otherwise well fitted for the purpose, inasmuch as its height greatly exceeds its width, consequently it is much better suited to show the convergence of vertical lines, than Mr. P.'s own plump and squat structure.—At all events, as it is intended as a model sample of the new system of Perspective, or "New Language of the Eye,"—a language somewhat akin to Irving's Unknown Tongues,—it would not have been amiss had it been correctly drawn; so far from which being the case, there are hardly above two of the vertical lines that converge to the same point, but some of those that are nearest to the axis of vision are much more inclined than those which are farthest off! which produces the same effect as a drawing in which the cornice or upper horizontal lines of a building should be made to incline less than those of a string-course or lower cornice at half the distance or less, above the eye. It may be that this is an error merely of inadvertence, but then it is a most extraordinary instance of carelessness indeed, because Mr. Parsey must have been aware that his sample drawing would be likely to be rather rigourously scrutinized, and that any blunder in it would consequently be laid hold of as an objection to the system itself. Admitting for a moment his doctrine of the convergence of vertical lines to be correct, his notions of convergence must be exceedingly *eccentric*, for the upright lines of the little stumpy turret on the building vanish much more suddenly than any of the others, so as to give it, even when compared with the rest, the appearance of being a truncated pyramid. We do not know how drawings according to the *vulgar* and now to-be-exploded system of perspective, appear to Mr. Parsey's eyes, but most certainly the one he here favours us with, appears to ours a most preposterously distorted delineation, and totally contrary to nature.

Yes, we are so hopelessly obtuse that all Mr. Parsey's eloquence is quite thrown away upon us when he assures us "This effect of nature *launched incessantly upon the vision of mankind*, as well from *perpendicular* as from horizontal surfaces, has never been recognized by theorists, neither is it found in works of art. It has evidently been a sheer omission." "The necessity of adopting this principle for the future," he goes on to say, "in the visual sciences will require no urging so soon as this truth and its consequences shall dawn upon the unbiassed intelligence of the world."—Which last remark is exceeding well put in, for that dawn seems to be quite as far off as ever. Notwithstanding that so great a luminary as Parsey has risen upon the intellectual horizon, we are as much in the dark as before, or else obstinately shut our eyes and refuse to be enlightened by Parsey's sunbeams.

It certainly is most unaccountable that the very class of persons who are most interested in this notable discovery, and who must of all others be best qualified to appreciate its value, so far from gratefully bearing testimony to its importance—so far from availing themselves of it, are precisely those who set their faces against it, and protest against it with one accord, not indeed, loudly, but assuredly most significantly by refusing, one and all, to make any use of it. When we see one artist—one architectural painter or draftsman begin to adopt it,—when such people as Roberts, Nash, Haghe, &c., whose drawings are in all other respects so admirable, lay aside the old-fashioned, incorrect, vulgar system, and becoming enlightened begin to *parseyfy* their productions, then indeed our own obstinate prejudices may begin to thaw and melt away.

No doubt we are exceedingly dull: our comfort is that we are by no means singular in that respect; for not only have many others altogether scouted the "New Language of the Eye"—which they rudely set down as being All my Eye and Betty Martin,—but neither the Western, the Marylebone, the West London and the Westminster, Literary and Scientific Institutions, "from all of which societies," says Mr. P., "I received most satisfactory and complimentary testimonials," have done any thing as yet to promote and diffuse the new science. Their testimonials may be complimentary, yet if Mr. Parsey considers them *satisfactory*, all we can say is that he is the most reasonable and most easily satisfied person we ever met with. Were the case our own, we should set down the complimentary part of the business, as mere matter-of-course humbug, as being of just as much value as "Your very humble servant" at the end of a letter of refusal. If notwithstanding their professed admiration of the author's theory, people do not care to apply it practically, their testimony in its favour, however complimentarily expressed, must stand for just nothing at all.

With the Institute of Architects—whose testimonial in favour of his system would have greatly outweighed those of merely literary societies—Mr. Parsey was not quite so successful, being peremptorily repulsed, on offering to give "a full and gratuitous explanation" of it to that body. Not satisfied, however, with one repulse, he renewed his application about two years afterwards, when he met with no better success than on the former occasion; as he himself relates at length in his Introduction, where he has inserted the notes he received from the Secretary Mr. Donaldson, and animadverts upon the prejudice and inconsistency shown by the Institute in refusing him permission to demonstrate to them his theory. Yet although he evidently seems to have no suspicion of such being the case, the refusal on the part of the Institute, was probably prompted by kindness, —by unwillingness to let Mr. Parsey not so much explain his principles as expose himself; because the main point of all in his theory, namely, the convergence of vertical lines, must have been tolerably well known to most of the members, it having been made the subject of more than one article in Loudon's Architectural Magazine, where, in fact, it had occasioned some controversy. The Architects undoubtedly knew enough of it, to be aware that it would not at all hold water—as the saying is, and accordingly declined his offer; nor do we think that his frontispiece is likely to gain him any converts in that quarter. Mr. Parsey makes no secret of the repulses he has met with from others, for he speaks of "non-replies to letters addressed to influential scholars,"—we almost wonder he did not address himself at once either to the Premier or the Secretary for the Home Department;—yet although he quotes our friend Candidus, he does not attempt to controvert either what that writer or Kata Phusin have said, fatal as their objections appear to be to his theory, unless they can be set aside; whereas by allowing them to remain unanswered, Mr. Parsey leaves us to infer that he considers them unanswerable.

We have already given it as our opinion that the Frontispiece is not attractive,—otherwise than by its oddity; nor do we think that, its new fangled doctrine apart, the volume itself is calculated for any practical service. On the contrary, it appears to us that Parsey's new light serves only to mystify the subject more than ever—absolutely to bewilder it; and his processes of delineation to be most complex and tedious. To say the truth, there has always been a great deal more mystery made about Perspective, than there is any occasion for, that is, as far as practice alone is concerned, since for that merely a few simple elementary rules are required, and were they but properly explained and elucidated, they would be all-sufficient. The great point of all in teaching the practice of perspective is to convince the learner at the outset, not of its difficulty, but of its easiness, to explain the principles intelligibly, and not only intelligibly, but intelligently also, and to show how those simple elements suffice for all combinations, and for the most intricate subjects. But to come to Mr. Parsey's hobby, or rather his *cheval de guerre*, the Convergence of Perpendiculars—by which we are to understand Vertical lines, we will not be quite sure that Mr. Parsey clearly understands himself, or if he does he has most certainly an unlucky, Mrs. Malaprop way of explaining himself; for an instance clearly demonstrating the natural convergence of perpendiculars, he refers us to the effect produced by looking *up* from the bottom of a deep shaft, or *down* into a well! Good Mr. Parsey, this is playing upon people's credulity rather too openly, for you might just as well have told them not to look into a well nor to walk into one, but to go into the shaft of the Thames Tunnel, and fancy that instead of looking straight before them in a horizontal direction they were looking upwards. Such effects as looking upwards, whether to the roof of "a lofty cathedral" or a low room, cannot be represented except on a horizontal plane over the spectator's head, as in a painted ceiling, for it is only such prodigious artists as Billings who can show us at once the effect of looking up into the lantern in dome of St. Paul's, and down upon the pavement, at the same instant. Except in very particular cases, such as those of ceiling pieces, giving effects of *di sotto in su*, all pictures are supposed to be vertical planes, or planes perpendicular to the horizon, which we therefore view not by looking either *up* or *down*, but straightforward at, and in which no more can be properly represented than can be seen under such angle as will enable the eye to take in at one view the greatest diameter or dimension, whether it be that of height or breadth. And until Mr. Parsey undertook to enlighten the world, both we and all artists, have ever fancied that all lines *parallel* to the picture continued parallel to each other in representation, no matter whether horizontal ones or vertical. Horizontal lines, indeed, generally converge, but then it is because they are situated *obliquely* to the picture; but that vertical lines can be so situated is utterly impossible, for then they would no longer be *perpendicular to the horizon*—that is no longer *upright* lines, but *sloping* ones. Consequently Mr. Parsey's doctrine either goes much too far, or else, does not go far enough. He is either much too daring, or much too timid, and fearful of following up his own principles consistently. He has no objection to say A, but it goes against him to say B. Either he must now give up *in toto* his new law in regard to Perpendiculars, or extend it also to Horizontal lines *parallel* to the picture. There is no other alternative for him; and how so very keen-sighted a gentleman could possibly have make such a "sheer omission" in regard to the last is to us quite inexplicable; more particularly as he himself calls notice to his own oversight—to the unlucky flaw in his doctrine, by remarking that the same laws apply to and govern both Vertical and Horizontal lines, on the strength of which axiom he founds his doctrine in utter opposition to it, referring us to the visible vanishing or convergence of horizontal lines *inclined*, or situated *obliquely* to the picture, in order to convince us that lines perpendicular to the horizon, and therefore *parallel* to the picture plane, ought to converge similarly!! The fact is, Mr. Parsey has built up his fine theory on utter rottenness, and laid the foundation of his notable theory on a mere quicksand.

Here we were just going to lay down our pen, when the thought came across us that *Parseyism* or the new light in perspective, may easily be put to the test by any one, by merely applying it—as through "sheer omission," we suppose, Mr. P. himself has neglected to do—to an interior view of a building, for as the end facing the spectator would by the rules of *Parseyfication*, alias the convergence of perpendiculars, be narrower at top than at bottom, the consequence must be that the sides would *incline forward*. If after this, Parsey's is not allowed to be a complete Mare's Nest, we can only say that John Bull is more of a John Gull than we took him for, and that he deserves henceforth to resign his roast beef, and diet himself upon *moonshine*.

A Practical Detail of the Cotton Manufacture of the United States of America, and the State of the Cotton Manufacture of that country compared with that of Great Britain. By JAMES MONTGOMERY. Glasgow: John Niven, 1840.

Mr. Montgomery is known as the author of the Cotton Spinner's Manual, and the Theory and Practice of Cotton Spinning, both works of established and deserved reputation. The present volume is not less important either to the manufacturer, the mechanic, the economist, or the Englishman who regards the prosperity of his country as connected with its great staple article of export. In the United States we see the country which most threatens our supremacy—our main producer of the raw material, our victor in many foreign markets, and our still more dreaded rival as the introducer of factory slave labour. Under such circumstances, and with the threatening future staring us in the face, this volume before us comes with an equal interest to that which it would ensure from its own merits. Our satisfaction in perusing it has been great, but how to communicate by any extract an equal degree of interest to our readers has appeared to us a task of some difficulty, for it is not easy to detach such a portion of a work so connected as shall do justice to the subject, and at the same time it is, of course, out of our power to give any thing like a sketch which shall include the details of a subject so diversified. We must therefore content ourselves with noting down such remarks as we think may prove most interesting to our readers.

The plan of the Mills, says our author, is nearly the same in the different districts, none exceed five stories in height, except two at Dover (U.S.), which are six stories on one side and five on the other. The general height of the mills is three or four stories with an attic; but the mills recently built at Lowell are five stories high with a plain roof, from which he infers as probable that although the double roof has been the plan generally adopted, that it is likely to be abandoned, as it is the most expensive, and does not give so much room for machinery as the five stories and a plain roof. The mills are generally strong and durable. Instead of joists for supporting the floors, there are large beams about 14 inches by 12, extending quite across from side to side, having each end fastened to the side wall by a bolt and wall-plate: these beams are about five feet apart, and supported in the centre by wooden pillars, with a double floor above. The under floor consists of planks three inches thick; the upper floor of one inch board. Some have the planks dressed on the under side, others have them lathed and plastered; the floor being in all four inches thick, is very strong and lasting. The average thickness of the side walls may be from 20 to 24 inches, and they are generally built of bricks, there being very few stone walls, from the scarcity of freestone.

In England the factories have joists about three inches by ten; these are laid on their edges about 20 inches apart, with one inch flooring above, lathed and plastered beneath, or sheathed with thin boards. The joists are also supported in the centre by a beam about 11 inches by 6, running from end to end of the building; the pillars are of cast iron, and placed right under this beam, which does not rest on the pillar, but on a cast iron case which passes upon each side of the beam, and meets together above, by which means the uppermost floors are supported on columns of cast iron from the foundation; there is therefore no danger of such floors sinking in the centre. In the United States where the cross beams rest on the top of the pillars, while the pillars above rest again upon the beams, the floors in the upper stories sink down in the centre, in consequence of the shrinking of the timber, and the pressure of the ends of the pillars into the beams. Mr. Montgomery says, that he has seen some of these which had sunk down four or five inches in the course of four years.

The mills in England are from six to eight stories high, Stirling and Becktow's mill, Lower Moseley-street, Manchester, is nine stories. The general height of those in Scotland is six stories with a plain roof. In the United States there are few mills driven by high pressure steam engines; four in Newport, one in Providence, Rhode Island, and three in Newburyport, Massachusetts. The coals used whether anthracite or bituminous, cost from seven to eight dollars per ton (30*s.* to 34*s.*) In general the mills are moved by water; and in constructing them the water-wheels are necessarily put under cover, so as to be kept in an atmosphere, considerably above the freezing point in winter, otherwise the severity of the frost, which frequently descends to nearly 30 degrees below zero, would prevent them from operating a great part of the year; hence the water-wheels are generally placed in the basement story, which besides the wheels contains the mechanics' shop and cloth room, or sometimes it is filled in whole or in part with machinery. The English cotton factories generally have their picking or scutching rooms within the mill: but in the United States there are separate buildings erected for these purposes, generally standing like guardhouses about 20 or 30 feet from the main building, with the passages that connect them secured with iron doors, to prevent the communication of fire to the loose cotton in the picking house.

The method of communicating motion from the first moving power to the different departments in the English factories is by means of shafts and geared wheels; but in America it is done by large belts moving at a rapid speed; these are of the breadth of 9, 12, or 15 inches, according to the weight they have to drive, and pass through a space of from 2500 to 3600 feet per minute. A belt of 15 inches broad, moving at the rate of 3000 feet per minute, is considered capable of exerting a propelling force equal to 50 horses' power. All the most recent mills are belted, while many of the older ones have had the shafts and gears removed, and belts substituted in their stead; indeed belts are generally preferred even by those who have had sufficient experience of both. A belt of ordinary size would be between three and four hundred feet long, from twelve to fifteen inches broad, and would require from six to seven hundred pounds of good belt leather to make it. Such belts are always made from the centre of the back of the hide, to that they may stretch equally at both sides. Mr. Montgomery further remarks that however partial American manufacturers may be to this mode of conveying motion to the different departments, those who have been accustomed to the neat manner in which factories are geared in England must regard the above as heavy, clumsy, and inconvenient, as well as more expensive. As all these belts have to be enclosed, they occupy a considerable portion of the rooms they pass through; which, besides interrupting the view, gives less space for arranging the machinery. They are likewise very liable to stretch, and when too slack, they will slip on the drums; and owing to their breadth, it requires a considerable time to cut one joining and sew them up again. As to whether belts have more or less power than English gearing, Mr. Montgomery states his inability to decide satisfactorily; different opinions prevail in America, but there are two mills at Fall River, Rhode Island, which are said to decide the question in favour of the belts.

With regard to the arrangement of the machinery, diversities also prevail. In England the weaving is generally in the lower stories, and the carding and spinning above; but in the States, the weaving is contained in the upper stories, with the carding and spinning below.

Mr. Montgomery next goes on to describe the several classes of machinery used in the States, and to point out the differences from those of England, and here we shall endeavour as far as we can to follow him. The first class is the Willow, in connection with which he says that the American Picker is very injurious to the cotton, and likely to [illegible] The W[illegible] Mr. Montgomery [illegible] called Mason's Willow, which he says is decidedly the best and occupies little room. In the English factories the scutching and spreading Machines are generally two separate machines, but across the Atlantic they are combined into one called the lap spreader, in which they have only one, two, or most three beaters or scutchers, while in England they have generally four or five. There are, says Mr. Montgomery, three most essential processes in the cotton manufacture which, in the factories of the United States are not so well attended to as in those of England. First, the cotton is not so well mixed; second, it is not so well cleaned; and third, it is not so well carded. With regard to the first our author is of opinion that by far too little room is allowed for the picking houses in the United States. Upon carding it is observed that few mills in the States use simple carding, mostly all have breakers and finishers, even those that manufacture the coarsest goods. The average speed of the cylinders there is about 100 to 110 revolutions per minute, there being no carding engines, driven at so high a speed as those in England, or which make work equal to those of the latter country. Indeed the English manufacturers generally make superior work with single carding to what the Americans do with double carding. The work before us says that it is the practice with them to crowd the cotton on to the cylinder so rapidly, that, instead of being taken away from the feeding rollers in single filaments, it is dragged in by the slow motion of the revolving cards in large flakes, which are not allowed to remain long enough under the operation of the tops, to be sufficiently teased out, the doffing cylinder being also driven too fast in proportion to the speed of the main cylinder. In England the practice is directly the reverse: the cotton is led into and delivered from the cards by a very slow motion: that is the motion of the feeding rollers and doffing cylinder, are comparatively slow in proportion to the speed of the main cylinder. For example, a main cylinder 36 inches in diameter will revolve between 70 and 80 times for one of the feeding rollers; in America their motions are as 35 of the former to one of the latter. The proportions of the revolutions of the main cylinder and doffer are in England as 25 of the former to one of the latter; in America as 17 to 1. The mode of stripping the cards adopted in the States is also inferior, as also that of grinding the cards. The drawing process is stated not to be so well performed, and to take twice the amount of labour across the Atlantic. The spinning warps Throstle Spinning Frames are universally used, except in some factories where very fine goods are made. They appear to be worked at a higher speed there, and with advantage, power being cheaper; Gore's Spindle which failed in Glasgow being most successful in the States. In weaving by power Mr. Montgomery considers that the Americans in every respect equal and in some things surpass any thing he has seen either at Manchester or Glasgow, particularly in common power weaving. In fancy weaving however they have not made a beginning. The spooling machine is cited as superior to that used in England, being much more simple, and capable of being attended by girls of 11, instead of women of 30. The warping machine is much the same as here; the dressing machines are entirely different, said to be more simple, more easily attended and kept in order, requiring less power and oil. The Power Looms are generally of improved construction.

We have we trust in this sketch shown enough of the merits of this work, to give a favourable idea of it to our readers, so that we shall conclude by congratulating Mr. Montgomery on this interesting contribution to the literature of a subject so important.

The Railways of Great Britain and Ireland. By FRANCIS WHISHAW, C.E. London: Simpkin and Marshall, 1840.

As we mean to pay several visits to this work, we shall for the present content ourselves with a few extracts, illustrative of the peculiarities of various lines, having in the meanwhile already said enough in our last notice to recommend it to the attention of our readers. Taking up the Aylesbury as the first subject, we find

This railway is laid to the English standard gauge, viz. 4 feet 8½ inches. Although the land taken is wide enough for a double way, being about 17 yards, there is at present only one pair of rails laid down from end to end. It is one of the rare instances of a railway being constructed entirely without river, road, or other bridges, which is owing to its peculiar locality; but there are five level road-crossings, and three of these are highways, which are furnished with folding gates, each 9 feet long, shutting both across the railway and roads, according as they are required.

The station at Aylesbury is conveniently laid out: a triple way, connected, at a convenient distance from the offices, with the main line, runs into a railway-dock 33 feet wide at its entrance, and 12 feet at its connexion with the [illegible] station, the [illegible] space of which is 4 feet 10 [illegible] the height of the quay, which has [illegible] batter of 2¾ inches, is 3 feet 4 inches; the quay on either side is about 10 feet in width. There is a carriage-dock 10 feet 8 inches in length and 8 feet 10 inches wide, furnished at its entrance with a proper turn-table, and abutting on the yard, conveniently situate for the arrival of common-road vehicles: the arrival door for passengers is at the booking-office, on the left side of the railway as you approach Aylesbury; the departure-gate is on the right side: for the whole length of the station there is a siding for carriages when not in use.

The booking-office and general waiting-room are in one; there is, however, a separate room for ladies. This is, upon the whole, one of the best-arranged stations for a short line of railway that we have any where met with.

On the Ballochney,

There is a self-acting plane of 1200 yards in length on that portion of the line next the Monkland Railway; the lower part being a single way, the middle part double, and the upper part formed with three rails. The ascending train consists usually of four loaded wagons, and the descending train of six or seven empty wagons; the time occupied in the ascent is 3·50 minutes; the rope used is about 4½ inches circumference; the sheaves are of 14 inches diameter, and are placed at intervals of 21 feet.

With regard to the Birmingham and Gloucester, Mr. Whishaw says,

The Lickey Incline of 1 in 37 extends for 2 miles 3·35 chains, and is, we understand, to be entirely worked by locomotive engines.

If this is satisfactorily effected, it will throw a new and useful light on the laying out of railways, and will save a vast original outlay in future works. We have long considered that the present system of making the sixteen feet gradient the *maximum*, is far from desirable. The advantages in working a railway thus graduated are not equivalent to the immense original outlay necessarily incurred by tunnels and overwhelming earthworks.

BRIDGES.—The whole number of bridges on this line is one hundred and sixty-two, besides one hundred and twenty-seven culverts. They are built of brick, of stone, of stone and iron, and some of wood. The span of arches over the railway is 23 feet; and the arches under the railway vary in span from 16 feet to 18 feet. The occupation-arches under the railway are each of 12 feet span.

There is a particular description of lattice-work wooden bridge used on this railway, which, we understand, was introduced from America by Mr. Hughes, the resident engineer; one of these we observed over a cutting near Bredon, which is about 117 feet in span, 17½ feet wide in the clear, about the same height, and 200 feet in extreme length.

The roadway planking is supported by transverse joists about 6 feet below the top rail of framing. These joists are placed about 3 feet from centre to centre, and have a bearing on each side on the middle rail, or band, which runs from one abutment to the other. Besides this band, there are two superior and two inferior bands, running the whole length of the lattice-work. Each end of the framing has a bearing on cross sleepers bedded in the solid ground in proportion to the span, and is let into a pedestal at each end. Beneath the level of the roadway, the lattice-work framing on each side is connected together with cross ties and braces, both of wood.

In order to give this bridge a horizontal appearance, the longitudinal timbers should have a slight camber. One of these structures, on our view of this railway, appeared to have sunk considerably in the middle.

The largest bridge is that which carries the railway over the river Avon, near Eckington. It consists of three cast-iron segmental arches, each of 73 feet span, and supported upon two lines of iron columns resting on iron caissons filled with masonry. The ribs and other castings of which this bridge is composed are not so sightly as they might have been; and the iron railing is of too studied a design for such a work. The whole length of this bridge is about 270 feet, and the clear width 23 feet. The total cost is stated to have been 10,000*l*.

It is a peculiar feature of this line, that although the rails are not laid throughout on longitudinal sleepers, there is an entire absence of stone blocks. This plan is gaining ground every day; and on some lines we have known sleepers substituted to a great extent for stone blocks, which had been originally introduced at great cost.

Of the travelling on the Brandling Junction our author seems to be by no means an admirer, for he says,

In consequence of opening this portion of the line at too early a period, the travelling over it was of the most extraordinary description we have experienced on any railway in the kingdom; for, besides the snail's pace at which the train proceeded, the motion of the carriages was precisely similar to that of a boat in a somewhat troubled sea.

It is an error, which most railway Companies have fallen into, to open their lines, or portions, before the embankments have sufficiently subsided to allow, if not of a safe, at any rate of an easy passage for the heavy trains made to pass over them. Some of the consequences of such hasty proceedings are to entail a large additional outlay on the proprietors, to bring discredit on the particular railway, and to give the now happily few enemies to the railway-system just cause for complaint.

A foot board on the carriages of the same line is more favourably noticed. The number of wagons seems large enough.

The second-class bodies, which are 14 feet 7 inches long, and 6 feet 2 inches wide, have also three compartments each, calculated to hold ten passengers. A footboard of wood, lined with plate-iron, runs along the whole length of the carriage on each side, and is of great convenience to the guards, who may thus safely walk along the side of the whole train when in motion.

There are nine goods-trucks, mounted each on Hawke's wheels.

There are upwards of 400 wagons at work on this line, built chiefly by Mr. Burnup, of Newcastle; but we were informed that the required number would be about 1500. The net weight of each wagon is about 44 cwt., and of size sufficient for 53 cwt. of coal. The wheels are of cast iron, 3 feet in diameter, and were generally furnished by Messrs. Hawkes and Co., of Gateshead. The cost of keeping a wagon in repair is estimated in this county at about 4*l.* per annum. The wagons are coated with tar—a practice which it would be very advisable for other railway companies to adopt.

With these few notes we must for the present leave Mr. Whishaw's work, observing that it contains a store of matter, from which we hope in our subsequent notices to extract, again impressing upon our readers the value of the present as a work of reference.

Gandy and Baud's Windsor Castle. Part II. London: Williams, 1841.

When Messrs. Gandy and Baud devoted themselves to the illustration of this national monument, they seem to have done so with a full determination to produce a work worthy the subject—a task which in this and the preceding number they have successfully carried out. The first of these fine plates presents us with a North West View of the Norman Gateway Towers and Queen Elizabeth's Building, a portion of the edifice in which two very dissimilar styles are placed in juxtaposition. This plate will we have no doubt be as great a favourite with the public as with the profession, for it unites great picturesqueness of effect with accuracy of delineation. Another work of the same class is the plate representing George the Fourth's Gateway and the York and Lancaster Towers, showing in the distance the Devil's Tower and the Great Round Tower. The elevation of Henry VII.'s and Queen Elizabeth's Gallery shows a range of building constructed under the several reigns of Henry 7th, Queen Elizabeth, Charles 2nd, Queen Anne, George 3rd and 4th, and William 4th, and made into one harmonious pile under the direction of Sir Jeffry Wyatville. Other plates in the work present a number of the details of the building, of great value to the student.

The promise held out by the publisher and conductors has been satisfactorily realized, so that we can have no hesitation in performing our duty of recommending most strongly this work to the patronage of the connoisseur, of the architect, of the student, and the public.

Excursions Daguerriennes. Part V. Paris.

We recommend this work to our readers. It comes out in numbers containing well executed engravings of scenes and buildings sketched by the Daguerréotype. In this publication the admirable capabilities of photography for architectural delineation is fully shown, and we have no doubt will prove extremely interesting. In this number are the Maison Carrée at Nismes, the Trajan column at Rome, the Church of Basil the Great at Moscow, and a view of the Mola at Naples.

A New Supplement to Euclid's Elements of Geometry. By the Author of a New Introduction to the Mathematics. London: Whittaker, 1840.

This is an ingenious work, by a well known author, propounding some new views, which will doubtless prove interesting to our mathematical readers.

Quarterly Railroad Journal, for January. Simpkin, Marshall & Co.

If no more railway bills pass, railway publications seem by no means afflicted with a similar sterility, for here we have before us a new contemporary. The *Quarterly Journal* contains several interesting papers on railway economy, emanating from one long experienced on the subject. Being devoted to the advocacy of the engineers against directors, it will doubtless be acceptable to many of our readers. We shall perhaps have occasion next month to advert to some of the views put forward, which will afford the best proof of the interest we take in this publication.

The Law and Practice of Letters Patent for Inventions: Statutes, Practical Forms, and Digest of Reported Cases. By Thomas Webster, Esq., of Lincoln's Inn, Special Pleader. London: Crofts and Blenkarn, 1841.

It is probably unfortunate for the author of this work that the nature of the subject upon which he treats is such as to prevent us from making extracts from it, such as would enable our readers to form an independent judgment upon it. They will perhaps however feel equal confidence when, without such testimonials, we refer them to Mr. Webster's book, as one which for clearness and completeness is much to be admired, whether as regards its application to this particular subject, or considered merely by a legal standard. The arrangement of the work is excellent, and the manner in which the information is epitomized not less so. Any one by a careful perusal of it, will be easily enabled to understand the rationale of a subject so important.

The Doctrine of Proportion clearly Developed, &c., or the Fifth Book of Euclid Simplified. By Oliver Byrne, &c. London: Williams, 1841.

"Censure on the works of others," says the author before us, "should be avoided as much as possible, because it shows the want of knowledge; those who know least, censure most: to correct a copy is easier than to produce an original; for men acquire criticism before ability, and it is mostly from those who possess no judgment that the most sweeping judgment comes." This is immediately followed by a general attack on Newton, Legendre, Simpson, Brewster, Professors Young and Leslie, Keith, Bonnycastle, Austin, Da Cunha, &c.

This is a very pretty brick from the work of Mr. Byrne, his book abounding with similar looseness and inconsistency. We will not quarrel with Mr. Byrne's definition of criticism, for he evidently does not know what it is, but at once dismiss him by observing that his book leaves the subject just where he found it, and that had he simply announced it as an edition of the Fifth Book with symbolical, arithmetical and algebraical expositions, we should have had less occasion for complaint at the nonfulfilment of his high sounding promises.

LITERARY NOTICES.

The fourth volume of the *Papers of the Corps of Royal Engineers* has been sent to us, but we have only time now to say that it appears to excel the character of its predecessors.

Another work published by Mr. Weale, *The Reports, Specifications and Estimates of Public Works in the United States of America,* must also be passed over for the present. It is a work of that magnitude and value that we should be doing injustice to it to attempt any cursory delineation of its contents.

ON THE COMBUSTION OF COAL.

Sir—With your permission I beg to offer some remarks on the review of my treatise "on the Combustion of Coal," inserted in the last number of your useful Miscellany. Commenting on a passage in my work, the reviewer observes, "is this a proof of the great value of coal as a heat-giving body? certainly not: it is the contrary; rather an evidence of the great quantity of heat expended in evolving the gas, which is no advantage, but very much the reverse." In my treatise I have strongly insisted on this point, as put by the reviewer, namely, the heat expended in evolving the gas, comparing it with the heat expended in converting ice into water, and water into steam. I fear however, the reviewer has overlooked the object I had in view, which was, not to shew, "the great value of coal gas as a heat-giving body," but as proof of the enormous quantity of it which coal contains, and the importance of turning it to account in the furnace.

The reviewer charges me with having made use of an improper term, and observes, that the expressions "bitumen, and bituminous portion" ought to be rejected, and, "gases and gaseous or volatile portion" substituted in their place. That the terms "bitumen," and "bituminous portion" are strictly speaking, not correct, is true, because, as Dr. Ure observes, "Coal contains no ready-formed bitumen, but merely its elements, carbon, hydrogen and oxygen." I beg however to observe, that the terms, "gases," and "gaseous portion" would not explain my meaning, for this reason, that the portion of the coal, which in common parlance is called "bituminous," is in a solid or fixed state while in the coal, and to which state I was then referring; though, subsequently, it is volatilizable and assumes the form of gas. I know, indeed, no other term by which these bituminous constituents, *while in the fixed state in coal*, and before they are volatilized, can be designated.

The reviewer observes, "these quotations [taken from page 26,] suffice to shew that the gases which result from the application of heat to coal, are considered by the author to be produced by *simple distillation* of the bitumen contained in the coal, which suffers thereby no alteration in its chemical composition; whereas, the truth is, that they result from the chemical decomposition of the bitumen, &c."

I beg to explain my meaning, by saying that I intended to convey the idea that the application of heat to coal expels the bituminous and volatizable part by a distillatory process, and in corroboration of this opinion I find Dr. Ure says, "the first operation which coal undergoes on being heated in a common furnace, is, *distillation*."

I accompany the present with Dr. Ure's letter, from which I have made the above quotations.

And am, your obedient servant,

C. W. WILLIAMS.

Remarks by Andrew Ure, M.D., F.R.S., on Mr. Williams's Treatise on the Combustion of Coal.

To C. W. WILLIAMS, Esq.

HAVING now carefully perused your treatise "On the Combustion of Coals and the Prevention of Smoke, Chemically and Practically considered," I cannot help congratulating you on the profound manner in which you have studied the phenomena of a furnace—phenomena which, like those of the freezing and boiling of water, had been for ages exhibited to the eyes of the philosopher and the engineer, without receiving from the one a scientific analysis, or leading the other to any radical improvement. You have fully demonstrated the defectiveness and fallacy of the ideas generally entertained concerning the operation of fuel in furnaces, and the errors, consequently, committed in their construction. Nothing places in a clearer light the heedlessness of mankind to the most instructive lessons than their neglecting to perceive the difficulty of duly intermingling air with inflammable vapours, for the purpose of their combustion, as exhibited in the every day occurrence of the flame of a tallow candle, or common oil lamp; for, though this flame be in contact, externally, with a current of air created by itself, yet a large portion of the tallow and oil passes off unconsumed, with a great loss of the light and heat which they are capable of producing. Your quotations and remarks upon this subject must convince every unprejudiced mind of the justness of your views as to the imperfect combustion of the inflammable gases given out by coals on the furnace grate.

By experiments with Dr. Wollaston's Differential Barometer, made in several factories, where both high and low pressure steam was employed, I found, that the aërial products of combustion from the boiler furnaces flew off with a velocity of fully 36 feet per second;* a rate so rapid as to preclude the possibility of the hydrogenated gases from the ignited coals becoming so duly blended with the atmospheric oxygen as to be burned. It is well known, that elastic fluids of different densities, such as air and carburetted hydrogen, intermingle *very slowly*; but, when the air becomes conbonated, as it does in passing through the grate, and, consequently, heavier, it will not incorporate at all with the lighter combustible gases above it, in the short interval of the aërial transit through the furnace and flues. Thus there can be no more combustion amidst these gases and vapours than in the axis of a tallow candle flame.

Your atomic representations are quite correct, and will please all those who delight in tracing the workings of nature into her formerly mysterious and inaccessible sanctuary.

You will remember that when, about ten months ago, you laid before me the first draught of the specification of your patent furnace, with what delight I hailed your invention as the harbinger of a brighter day for steam navigation, where economy of fuel has become the *sine quâ non* in regard to long voyages. I rejoice that, with the ample means placed at your command, you have since prosecuted the subject, through all its ambiguities, to a clear and conclusive demonstration of the efficacy of your plan for calling forth from pit-coal all its dormant fire, and diffusing it most efficaciously over the surfaces of boilers and along the flues. I am more particularly pleased with your analysis of the combustion of the gases and vapours given out by hydrogenous coal, commonly, though incorrectly, called bituminous, for it contains no ready-formed bitumen, but merely its elements, carbon, hydrogen, and oxygen.

Having been much engaged, during the two preceding years, in experimental researches upon the calorific powers of different species of fuel, † I became aware that the hydrogenous constituents of coal underwent a most imperfect combustion, and found I had been misled for some time to the false conclusion, that the caking Newcastle coals afforded less heat than the non-hydrogenous anthracite of Wales. When I improved my method of burning the gaseous products first disengaged from coals, I obtained a greater quantity of heat from the so-called bituminous species; a result quite in accordance with long established chemical data. The immortal Lavoisier and Laplace ascertained, that one pound of hydrogen, when burned in their celebrated calorimeter, melted 295·6 lb. of ice, while one pound of charcoal melted only 95·6 lb., quantities very nearly in the ratio of 3 to 1; Despretz gives the ratio of 315 to 104; thus proving beyond a doubt, that hydrogen can disengage, in its combustion, three times more heat than the same weight of charcoal. It deserves to be remarked, that this ratio is exactly the inverse of that in which hydrogen and carbon unite with oxygen; for 1 part of hydrogen, by weight, combines with 8 of oxygen to form water; and 3 parts of carbon combine with 8 of oxygen to form carbonic acid gas, which is the product of the complete combustion of charcoal. From these and similar researches, chemists have been led to conclude, that the heat afforded by different bodies in the act of their combustion is proportional to the quantity of oxygen which they consume; a conclusion which accords, also, with the principle, that the intensity of heat is proportional to the intensity of chemical action, as measured by the proportion of oxygen which enters into combination.

For the first accurate analysis of pit-coals, we are indebted to Mr. Thomas Richardson of Newcastle,* who published, a few years ago, in the eleventh volume of Erdmann's Journal für Chemie, the results of an excellent series of researches on coals, made in Professor Liebig's laboratory. He used the fused chromate of lead to oxygenate the carbon and hydrogen of the coals, with Liebig's new apparatus; and his results deserve entire confidence. In the earlier analyses of coals, made by Dr. Thomson, myself, and others, the peroxide of copper, which was employed to oxygenate the combustible matter, always left some of the carbon unconsumed, and thus occasioned unavoidable errors.

1. Rich caking coal, from Garesfield, near Newcastle, of sp. grav. 1·280, was found to contain as follows:

Carbon	87·952
Hydrogen	5·239
Azote and oxygen	5·416
Ashes	1·393
	100·

2. Caking coal, of excellent quality, from South Hetton, in the county of Durham, of sp. grav. 1·274, afforded,

Carbon	83·274
Hydrogen	5·171
Azote and oxygen	9·036
Ashes	2·519
	100·

3. The parrot coal of Edinburgh afforded,

Carbon	67·597
Hydrogen	5·405
Azote and oxygen	12,432
Ashes	14·566
	100·

100 parts of these several kinds of coal take for perfect combustion (subtracting the oxygen contained in the coal) as follows:

1st. 266·7	parts of oxygen: giving out heat as the number	122·56
2nd. 250·2	,, ,, ,,	114·98
3rd. 217·6	,, ,, ,,	100·00

The quantity of heat is here presumed to be proportional to the quantity of oxygen consumed. M. Regnault published, in Erdmann's Journal, vol. xiii., p. 69, the following statement of his analysis of coals, which is regarded by Professor Löwig as very correct:*

Newcastle coal, of sp. grav. 1·280, affording a much inflated coke, (quite akin to the Garesfield coal, if not the same,) was found to consist of carbon, 87·95; hydrogen, 5·24; azote and oxygen, 5·41.

A Lancashire coal, of sp. grav. 1·317, which afforded an inflated coke, was found composed of carbon, 83·75; hydrogen, 5·66; azote and oxygen, 8·04. The quantity of azote is not given separately by either Mr. Richardson or M. Regnault; but it is known to be inconsiderable. The deficit to 100 in his analyses represents the amount of ashes per cent. Mr. R. says: "With the present means of analysis at our disposal, it is impossible to determine the true amount," (of azote,) "but the coal cannot contain more than two per cent." In the Edinburgh coal he found, by an experiment made on purpose to determine this point, 0·38 per cent. of azote. This uncertainty introduces a proportional ambiguity into the calculation of the quantity of heat evolved, from the quantity of atmospherical oxygen consumed. The less the proportion of azote, in the above analysis, the greater will be that of the oxygen directly combined with the coals, and the less atmospherical oxygen, of course, will be consumed, which is the only source of the heat disengaged.

Since it is the proportion of hydrogen in coal that determines the proportion of volatile products, a tolerable approximation upon this point is afforded by the proportional loss of weight which different coals suffer from ignition in retorts or covered crucibles. I found that 100 parts of the Felling-main coal used by some of the London Gas Companies, when strongly ignited in a covered crucible, well-luted, lost 37·5 per cent., leaving 62·5 of a porous coke. The Llangennock coals from Caermarthenshire, of sp. grav. 1·337, lose by ignition only 15·5, and leave 84·5 of a rather dense coke, which contains 3 of ashes. In furnaces of the common construction about London this coal affords much heat with little smoke, and is, therefore, greatly in request, and fetches a high price. 100 parts of the Tanfield Moor coal, of sp. grav. 1·269,

† An account of these experiments was laid before the meeting of the British Association, at Birmingham, and printed in the *Athenæum* of September 14, 1839.

* Experimental Inquiry into the Modes of Warming and Ventilating Apartments, in reference to the Health of their Inmates. By Andrew Ure, M.D., F.R.S. Read before the Royal Society, 16th June, 1836.

* An account of these experiments has been since presented, by Mr. Richardson, to the Natural History Society of Newcastle-upon-Tyne, and is printed in their Transactions, vol. ii., p. 401, and in the London and Edinburgh Philos. Magazine, vol. xiii., p. 121, for August, 1838.

† Chemie der Organischen Verbindungen, vol. ii., p. 88.

preferred by blacksmiths for their forge on account of its calorific strength and freedom from sulphur, give off in ignition 32·5 parts, and leave 67·5 of a bulky, compact coke.

Every coal which contains much hydrogen, and, therefore, loses much weight by ignition in retorts, necessarily produces much smoke, with a great waste of heat in our common steam boiler furnaces, for reasons which you have so well developed in your treatise. "When a carburetted hydrogen," says Liebig, "is kindled, and just as much oxygen admitted to it as will consume its hydrogen, the carbon does not burn at all, but is deposited (or separated) in the form of soot; if the quantity of oxygen is not sufficient to burn even all the hydrogen, carburets of hydrogen are produced poorer in hydrogen than the original carburetted hydrogen."* The above gas and smithy coals which, from their richness in hydrogen, are capable of affording the greatest proportion of heat by thorough combustion, afford often a much smaller quantity than the Llangennock, because the carburetted hydrogen which they so abundantly evolve is not supplied with a *due* quantity of oxygen, and hence much of their carbon goes off in smoke, and their sub-carburetted hydrogen gas in an invisible form. These results are quite accordant with my experiments on these coals with my calorimeter. At first, from certain defects in the apparatus, whereby the coals were imperfectly burned and a good deal of smoke was disengaged, I found that the best coals imported into London, such as Lambton's Wallsend, Hetton Do. and Pole's Main, afforded a smaller proportion of heat than the Llangennock, or even anthracite; but, when I diminished these defects, I obtained much more heat from the Tanfield Moor coal than from the Llangennock, and more from this than from the anthracite. In fact, a coal which, like the Newcastle caking coal, contains 5·239 of hydrogen, is capable of giving out in complete combustion as much heat as if it contained an extra $10\frac{1}{2}$ per cent. of carbon; but, instead of this additional heat, it affords in common furnaces much less heat than the Llangennock, though this is much poorer in the most calorific constituent, viz., the hydrogen.

It is a remarkable fact, that an inflammable constituent of pit-coal, which is always present, and often invisibly combined with it to the amount of 5 per cent. or more, has never been noticed in any of the ultimate analyses hitherto published. I have examined a great variety of coals from different parts of the world, and I have seldom found less than 2 per cent. of sulphur in them. Now, this is a circumstance of great consequence to many manufacturers, and most essentially to iron-masters. Some of my results upon this subject were published in the number of the Athenæum above quoted. Sulphur in its calorific power ranks low, being, according to Dr. Dalton, one-half of carbon. If we assume its consumption of oxygen in combustion as the measure of its heating power, it will stand to carbon in the relation of 3 to 8; for 3 parts of carbon consume 8 of oxygen to form carbonic acid, while 8 of sulphur consume 8 of oxygen when they are burned into sulphurous acid. The blacksmith knows well what havoc a sulphurous coal makes among his iron in the forge, rendering it entirely *rotten*. The same operation takes place upon the rivets and plates of steam-boilers, when the sulphur of the coals is merely volatilized, without being mingled with sufficient air to burn it.

The first operation which coals undergo on being heaved into a common furnace, is distillation, attended with a great absorption of heat, and may be compared to the distillation of sulphur in the process of refining it, for which purpose much external heat is requited. But, if the fumes of sulphur or the coals be, after accension, intermingled with the due quantity of atmospherical oxygen, they will, on the contrary, generate internally from the beginning their respective calorific effects.

At the outset of my chemical career I suffered in a painful and dangerous way from the refrigeration produced by throwing some pit-coal into a hot furnace. I was extracting oxygen, for common class experiments, from nitre ignited in a large iron bottle, when, having replenished the fire with coal, the gas became condensed in the bottle so much as to occasion a regurgitation of water into it from the gasometer basin, which water, being instantly converted into high-pressure steam, drove out a quantity of red-hot nitre upon my shoulder and arm, so as to burn not only my clothes, but a very considerable portion of my skin. In an experimental furnace, so treated, the heat is greatly damped as long as the hydrogenated vapours and gases are being generated; and it becomes again effective only when the coals have become nearly charred. Were there a contrivance like your patent invention introduced into the furnace for diffusing atmospherical oxygen through the said vapours and gases, no vexatious refrigeration could ensue from feeding the fire prudently, with common pit-coal; and the external orifice through which this smoke-burning air was admitted, might be closed whenever the fire became clear.

In the case of great steam-boiler furnaces, for which your patent is especially intended, since these are fed at short intervals, your plan of distributing atmospheric air, in a regulated quantity, by numerous jets, through the body of the gasiform matter, is peculiarly happy, and enable you to extract the whole heat which the combustible is capable of affording. The method also which you have contrived for distributing the air under the surface of the grate will ensure due combustion of the coked coals lying there, without admitting a refrigerating blast to the fire. And, finally, your mode of supplying atmospherical oxygen will prevent the possibility of the carbon of the coals escaping in the state of carbonic oxide gas, whereby, at present, much heat is lost in our great furnaces.

ANDREW URE.

1, *Charlotte-street, Bedford-square, London,*
December 26, 1840.

* Traité de Chimie Organique. Introduction. p. 32.

LECOUNT'S HISTORY OF THE LONDON AND BIRMINGHAM RAILWAY.

SIR—In your last number you have unintentionally done me an injury, which I have no doubt you will redress by admitting this letter. I allude to your stating that my history of the London and Birmingham Railway is a reprint from Mr. Roscoe's. I beg to say this is not the case beyond the 32nd page; the remainder of my work is what it proposes to be, a history of the railway in question, which Mr. Roscoe's is not beyond page 32—after that point I had nothing whatever to do with it, principally on the account that it was professing what was not to be performed. My name being connected with it is a perfect hoax upon the public; I never saw a proof sheet after page 32; and I may add that what I furnished for that work, although done under a written agreement, has never got me a sight of sixpence of the publisher's money. Beyond the point named it may be just as correctly called my history of the Cock Lane ghost, as my history of the Birmingham railway; I had nothing whatever to do with it except as above explained

Your obedient servant,
P. LECOUNT.

Wellington Road, Birmingham,
January 7, 1841.

[We should regret extremely that any unintentional error of ours should be the means of injuring Lieut. Lecount, for whose public services we entertain great respect, perhaps his letter will be deemed a sufficient explanation. —ED. C. E. & A. JOURNAL.]

IMPROVEMENTS ON ECCENTRIC RODS.

Fig. 1.

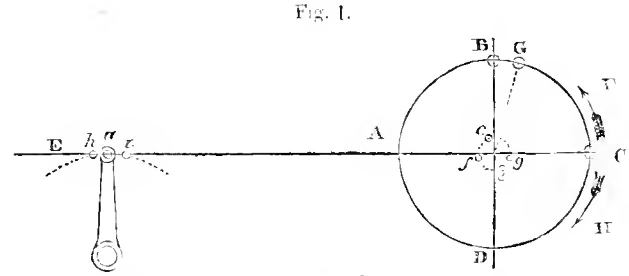
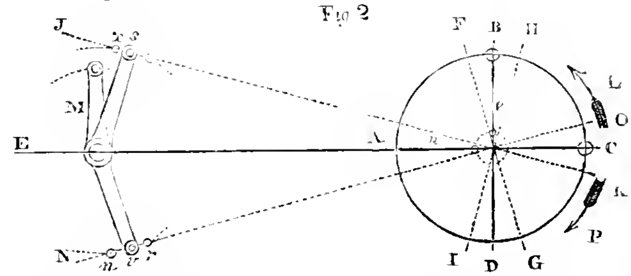


Fig 2.



[We very much regret that, through the inadvertence of our wood engraver, several letters of reference were omitted in Mr. Pearce's diagrams given in last month's Journal; we have therefore thought it our duty to re-insert them, together with the following communications.]

SIR—I beg to call your attention to my communication on Eccentrics for working the slide valves of Locomotive Engines, which you were pleased to insert in the last number of your widely circulated Journal.

On reading the explanation of the engravings, I find that the greater part of the letters of reference are not inserted in the figures; this omission, I think you will perceive, renders the most important point of the subject unintelligible, and I have, therefore, taken the liberty to apprise you of the same, hoping that you will be induced to correct the deficiency by the insertion of the figures complete in your next number. I also beg to point out the two following typographical omissions. In the 5th line of the 6th paragraph, instead of "Suppose it to be, &c." it ought to have been "Suppose *the crank* to be, &c.," and in the 11th line of the last paragraph, instead of "caused to be, &c." it ought to have been "caused *not* to be, &c."

I remain, Sir,
Your obliged servant,
JOHN C. PEARCE.

Leeds,
Jan. 13*th*, 1841.

Sir—I have subscribed to your periodical from its commencement, and received from it much pleasure and useful information. I have been still more gratified of late with the increase of space devoted to my favourite study, mechanics, and it is to a paper of this nature in your January number, that I wish at present to direct your attention. A correspondent of the name of John Charles Pearce describes, at considerable length, a contrivance for reversing a steam-engine with one eccentric as an invention of his own, although it has long been quite common in this country. I may mention, as an example, a high-pressure engine of about 20 horse power, built for some experiments with a canal boat on the Forth and Clyde Canal, and afterwards altered as a pumping-engine for a dry dock at Grangemouth, in which the identical contrivance was applied successfully.

I am,
Your constant reader,
An Apprentice.

Glasgow,
11th Jan. 1841.

Sir—If I am trespassing too much on your columns by thus a second time requesting the favour of a place therein, I beg you will suppress, curtail, or defer, as you think best, the following remarks which I am induced to send you after the perusal of a communication from Mr. John Charles Pearce, inserted in your number for the present month.

Mr. J. C. Pearce is correct in his observation as to the possibility of working Locomotive Engines by two fixed eccentrics, but he overlooks an objection to this system which, with your permission, I will take the liberty to point out: previous however to entering upon the objection, it will be proper to explain a few conditions, which are inseparable from this system of two fixed eccentrics and in one of which, originates the above mentioned objection.

No. 1. The eccentric must precede the crank in its action, when the engine is going forward, otherwise no *lead* can be given without a complication of levers: a slight objection was made to this, inasmuch that for going forward, the eccentric rod must work the upper pin of the double lever of the valve motion, and must be held in gear, so that should any thing get wrong in the hand motion, the eccentric rod would fall out of gear, and would thus reverse the engine.

No. 2. The crank being placed in a horizontal position, so that the piston may be at one end of the cylinder, the eccentric must be placed exactly perpendicular to Mr. J. C. Pearce's line C E. which is a straight line drawn through the centre of the crank shaft, and the lever spindle of the valve motion.

No. 3. The *amount* of *lead* depends upon the length of the eccentric rod. The shorter this rod is the greater will be the *lead*.

No. 4. The *lead* being determined by the length of this rod must remain invariable unless you move the eccentric on the axle, in which case you increase the *amount* of the *lead* one way, *but you diminish it for the reverse motion.*

This last circumstance has been deemed objectionable, because with varying loads and speed, it is desirable to have the power of augmenting or diminishing the *amount* of the *lead*.

Several engines are at work on the Paris and St. Germain railway fitted each with two fixed eccentrics, upon the principle laid down by Mr. J. C. Pearce, and for which a patent was obtained in Paris, I believe in 1838. They work well, but in consequence of the above mentioned inconveniences are being fitted with four eccentrics.

I have had several opportunities of comparing the duty done by these engines with that of others having four eccentrics, and at work on the same line, and have found very little difference in their results. I have reason to believe that the determination to alter them, originated more than from any other cause, in the desire of the Company to assimilate all their engines, by adopting one uniform system of eccentric motion; it is proper here to observe that the eccentric rods of these engines were originally made too long, and did not give sufficient *lead* to the valves, that in consequence thereof, the eccentrics were advanced a little on the shaft, so as to give the required *lead* for going forward, and the engines were *thus rendered slow the back way.*

The same Company fitted a pair of fixed eccentrics to another engine, paying proper attention to the length of the eccentric rods in order to obtain the required *lead* both ways; the eccentric rods were in this instance so short, as to work with a disagreeable motion, because the suspension pin of the hand lever motion, which in consequence of the shortness of the eccentric rods was attached to them, comparatively nearer than usual to the eccentric, occasioned an up and down motion of the fork upon the pin of the lever of the valve motion, which made it requisite to make the parallel clutch of the fork much deeper than usual, to prevent it from flying out of gear; this might, it is true, have been easily remedied, but the Company not being willing to make any further outlay in experiments, and desirous to have their engine, replaced the whole affair by four eccentrics.

The most serious objection made to the two fixed eccentrics, in my opinion, rests on the impossibility of varying the *lead of the valves both ways.*

The original plan adopted of two moveable eccentrics is a very good one, because if any thing gets out of order with the motion, you can always work home by hand. The main objections are, their expence, and the difficulty of getting them sufficiently strong.

The four eccentrics act perfectly well, but render the valve motion so very crowded, as to be frequently inconvenient.

A very ingenious method has been proposed and executed by Messrs. Hawthorn, brothers, of Newcastle-upon-Tyne, for replacing the eccentrics altogether, by a motion taken from the body of the connecting rods: the *lead* has been very cleverly determined by these gentlemen: the same objection however exist as to the difficulty of varying the *lead*, which could only be removed by complicating the motion. I have seen an engine of this description at work and giving satisfaction.

I remain, Sir, your very humble servant,
H. E.

London, January 16, 1841.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Jan. 11.—J. B. Papworth, Esq., in the Chair.

A paper was read by Mr. E. I'Anson, Jun., Fellow, comparing the Campanili of the lower ages in Italy, with those of the Norman period in England. The matter of Mr. I'Anson's discourse went to illustrate that highly interesting subject, the spread of the Romanesque style of architecture, and the modifications it underwent in its progress.

Jan. 25.—H. E. Kendall, Esq., in the Chair.

A paper was read on the Construction of the Reservoirs from which Venice is supplied with fresh water, by C. Parker, Fellow. This city being dependant on the clouds for a supply of this most necessary element, means are provided for collecting the rain water in immense tanks, which it enters by filtration through beds of sand, the means by which natural reservoirs are fitted, and their contents purified, being in fact imitated by art. The mode of constructing and puddling these tanks was described in detail, and illustrated by plans and sections.

An Artesian well lately constructed at the Surrey County Lunatic Asylum, was described by Mr. S. Lapedge, Associate, and a section exhibited of the strata through which the borer has passed, to the depth of 347 feet. The water rises from a bed of dark sand to within 30 feet of the surface, and a well 190 feet deep forms a reservoir, which constantly affords a supply sufficient for the purposes of the establishment.

A drawing was presented and a discussion read of a timber bridge erected at Hulne Park, by Mr. Barnfather, architect. It is an arch of 100 feet span and 5 feet rise, constructed of balks of timber raised to a curve by means of iron wedges, and remarkable for the simplicity and economy of construction. This principle was introducted from America about 25 years ago.

The Secretary for foreign correspondence, Mr. Donaldson, read a communication from Baron Gasparin, President of the Comité Historique des Arts et Monumens, at Paris, accompanying a donation of the bulletins (or reports) of the committee.

SOCIETY OF ARTS FOR SCOTLAND.

Dec. 14, 1840.—Dr. Fyfe, President, in the Chair.

Mr. Galbraith read a paper *on Trigonometrical Levelling, and on the effects of a supposed local attraction at the Calton Hill, Edinburgh.* In the first part of the paper he detailed a number of observations which he had made for the purpose of determining the amount of atmospherical refraction, and described a formula for its computation considerably simpler than that in use. In the second part of his paper he detailed a series of observations for the purpose of determining the latitude of the observatory of Edinburgh, to which he had been led by a known discrepancy between the latitude determined by Professor Henderson, from observations made by the mural circle, and the latitude found from the observations made on Kelly Law, in Fife, by help of the Ordnance zenith sector. It having occurred to him that the rising of the country to the southward of the Calton Hill, and the slope northward to the Firth of Forth, may cause a local disturbance of the plumb line, he resolved on deducing the latitude of the Observatory from observations made on Inchkeith, in the middle of the Firth, where the local attractions may be expected to be balanced. The determination of the latitude of Inchkeith Light-house agreed within half a second with that found by the Ordnance surveyors, but differed by *seven seconds* from that deduced by transference from the Observatory. On this account the author conceived that the probability of the existence of a local attraction at the Calton Hill was strengthened. The paper was ordered to be printed.

Mr. Alexander exhibited *a working model of the Electric Telegraph*, having premised that the model was intended merely to illustrate elementary principles. This instrument contained a separate wire for each distinct signal: the exhibition of it gave rise to an interesting conversation, in which a number of the members took part. Mr. Ponton adverted to the modification which he had exhibited two years ago to the society, in which a sufficient number of signals were obtained by the use of three wires only; he also mentioned that during the exhibition in the Assembly rooms, he had openly talked of a method of reducing the number of wires to two, by introducing the element *time*, a simplification which has since been wrought out and patented by Professor Wheatstone.

Mr. James Robertson, late in the service of the Shah of Persia, read a paper *on the method of manufacturing Bricks in Persia*; in which a lucid and very interesting description was given of those peculiarities in the construction of the brick-kilns which are consequent on the scarcity of fuel, and the peculiarity of what fuel can be obtained. Mr. Robertson was requested to allow his paper to appear in the transactions.

Jan. 11. 1841.—The President in the Chair.

Mr. Gavin Kay exhibited *a model of a boat on skates*, which he proposed as an apparatus for saving the lives of persons who have fallen through the ice. The exhibition of this model led to an animated conversation concerning the general subject, in the course of which Dr. Hunter, Mr. Sang, and Mr. Glover, expressed opinions decidedly hostile to any cumbrous apparatus; Mr. Sang and Mr. Glover particularly insisted on the propriety of having a few men drilled to manœuvring on the frequented lochs; and the society, after thanking Mr. Kay for his communication, requested Mr. Glover to draw up a paper embodying the opinions which seemed to have prevailed, and particularly the lucid views which he himself had given.

Mr. Rose read a description of *an instrument for indicating the amount of inclined disturbances during the shocks of an Earthquake*. In introducing the subject, Mr. Rose stated that since this communication had been billeted, the very same instrument had been exhibited to the Royal Society (Edinburgh), and that, in consequence, he had thought of withdrawing the notice. Having been dissuaded from this intention, he felt it necessary to offer some explanation. The explanation was to the effect that Mr. Mylne, having been requested, along with a committee of the British Association, to devise instruments for registering the disturbances caused by earthquakes, had consulted him, and having received a description and sketch, had employed Mr. Jamieson, assistant to Mr. Lees, to construct one. This instrument Mr. Mylne had exhibited along with others to the Royal Society, without taking any notice of Mr. Rose. The instrument contained a pendulum suspended by a ball-and-socket joint, the lower extremity of the pendulum carrying a piece of chalk, which might trace, upon a blackened spherical surface, a line to indicate the amount and direction of the inclination. Mr. Rose explained that some slight friction is needed, in order to prevent the free swinging of the pendulum, and he added that very little information could be expected from instruments of this class, since, in localities where the shocks are slight, the indicators may be deficient in delicacy, while, on the occasion of severe shocks, the instrument and observers may be involved in the common ruin. Sir John Robison pointed out a difficulty which might occur in interpreting the readings of the instrument, and suggested a hollow but very flat cup containing mercury; in the sides of the cup were to be drilled a multitude of small holes, which, in the event of any disturbance, might receive and retain part of the mercury. After some conversation among the members, thanks were voted to Mr. Rose.

Mr. Thomas Davidson exhibited a simple but important *improvement in the camera for taking portraits*. This improvement consisted in placing a stop between the lens and the image, so as to cut off the worst portions of the refracted light. He also described a method proposed for the purpose of taking views by reflection. His method was to employ a perfectly spherical reflector, having a stop placed around the centre of curvature; by this means all parts of the image are obtained of equal distinctness. Sir John Robison, Dr. Hunter, and Mr. Bryson made some remarks, and Mr. Sang pointed out that the curvature of the image in this arrangement would be a source of great inconvenience. These communications were remitted to a committee.

MEETINGS OF SOCIETIES IN FEBRUARY.

At Eight o'clock in the Evening.

Institution of Civil Engineers, Tuesday	2	9	16	23
Royal Institute of British Architects, Monday	8	22		
Architectural Society, Tuesday	9	23		

STEAM NAVIGATION.

THE VOYAGE OF THE NEMESIS.

(From the Colombo Observer, Oct. 12.)

In this splendid vessel, commanded by Captain W. H. Hall, we have the pleasing task of welcoming to our shores the first iron steamer that ever rounded the Cape of Good Hope. She is the largest of her class built, being 168 feet long, 29 feet beam, and 650 tons burden. The engines are 120 horse power, by Messrs. Foster and Co., of Liverpool, and, of course, upon the best construction. Twenty days' coal can, on any emergency, be stowed in her. She carries two medium 32 pound pivot guns, one after the other forward, and 10 swivels, and is manned by 50 seamen. When launched she drew only 2½ feet water, and may still be lightened, if necessary, to 4½ feet. Being nearly flat-bottomed, and fitted with iron hawse holes for cables in the tern, she can be run on shore and easily got off again by anchors, which contrivances will enable her, in many cases, to land troops without the assistance of boats. Though thus round-bottomed, two wooden false keels, of six feet in depth, can be let down through her bottom, one after another, forward. These, together with a lee-board invented by Captain Hall on the voyage, prevent her, in a considerable degree, from going to leeward. The rudder has a corresponding construction, the true rudder going to the depth of the sternpost, and a false rudder being attached by a pivot to the former, so that it can be triced up or let down to the same depth as the false keels. The floats are easily unshipped, and under canvass, with the wind free, she can go 9 or 10 knots an hour. The vessel is divided by water-tight divisions into five compartments, so that though even both stem and stern were stove in, she would still float. Her accommodations and arrangements of small arms are splendid, and large coal-holes being placed, both between the officers' quarters and the sailors' berths and the engine-room, the heat of the fires is not at all felt. The Nemesis left Portsmouth with secret orders on the 28th of March, and reached Madeira in seven days, where she took in coals, then proceeded down the coast of Africa, steaming or sailing according to circumstances, but she experienced principally adverse winds and currents. At Prince's Island, a Portuguese settlement, she took in 70 tons of wood, which, with the remaining coals, lasted till she came into the latitude of St. Helena, when she proceeded under canvass, in order to make the best of her way to Table Bay thus facing the Southern Ocean at the very worst season of the year.

She arrived at Table Bay on the 1st of July. The Governor and suite having gone on board, she slipped from her anchorage and steamed round the bay, trying the different range of her guns. Having taken in about 200 tons of coals and water, she left Table Bay on the 11th of July, and whilst rounding the Cape, as was to be expected at that most unfavourable season, experienced several gales of wind. One of these, in particular, was most tremendous, but, to the agreeable surprise of those on board, the steamer proved to be an admirable sea-boat, rising over the immense waves with the greatest buoyancy, and shipping little or no water. She, however, received so much damage in these gales, that Captain Hall put into English river, Delagoa Bay, to repair and refit. This occupied three weeks, but was done most effectually by those on board, as she carries first-rate artificers and ample means at their disposal.

From Delagoa Bay the Nemesis proceeded to Mozambique, thence she continued her voyage towards India, calling at Johanna. She then went direct through the Maldive islands to Ceylon, sighted Colombo on Monday morning, the 7th, and reached Point de Galle the same afternoon.

The Nemesis will have to wait a few days at Point de Galle until the arrival of commissariat and other stores from Colombo, when it is supposed she will proceed to Singapore, and ultimately to China.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 28TH DECEMBER, TO 28TH JANUARY, 1841.

Six Months allowed for Enrolment.

John Buchannan, of Glasgow, Coach Builder, for "*improvements in wheel carriages for common roads or railways*."—Sealed December 28.

William Bridges Adams, of Porchester Terrace, Gent., for "*improvements in the construction of wheel carriages, and of appendages thereto*."—December 28.

John Wells, of Vale Place, Hammersmith, Gent., for "*certain improvements in the manufacture of coke*."—December 30.

William Henry Kempton, of the City Road, Gent., for "*improvements in cylinders to be used for printing calicoes and other fabrics*."—Dec. 30.

Henry Adcock, of Winstanley, Civil Engineer, for "*improvements in the means or apparatus for condensing, concentrating, and evaporating aeriform and other fluids*."—December 30.

William Heusman, of Woburn, Machinist, for "*improvements in ploughs*."—December 31.

Joseph Parkes, of Birmingham, Button Manufacturer, for "*improvements in the manufacture of covered buttons*."—December 31.

William Newton, of Chancery Lane, Civil Engineer, for "*improvements in the rigging of ships, and other navigable vessels*." Communicated by a foreigner.—December 31.

Francis Burdett Whitaker, of Royton, Lancaster, Cotton Spinner, for "*improvements in the machinery or apparatus for drawing cotton and other fibrous substances, which improvements are also applicable to warping and dressing yarns of the same*."—December 31.

Joseph Stubs, of Warrington, File Manufacturer, for "*improvements in the construction of screw wrenches and spanners, for screwing and unscrewing nuts and bolts*." Communicated by a foreigner.—December 31.

Thomas Robert Sewell, of Carrington, Nottingham, Lace Manufacturer, for "*improvements in obtaining carbonic acid from certain mineral substances*."—December 31.

William Henry Kempton, of Pentonville, Gent., for "*improvements in lamps*."—December 31.

John Grylls, of Portsea, for "*improvements in machinery used for raising and lowering weights*."—December 31.

Joseph Haley, of Manchester, Engineer, for "*an improved lifting jack, for raising or removing heavy bodies, which is also applicable to the packing or compressing of woods or other substances*."—December 31.

Louis Holbeck, of Hammersmith, Gent., for "*improvements in obtaining or producing oil*." Communicated by a foreigner.—December 31.

Henry Scott, of Brownlow Street, Bedford Row, Surgeon, for "*improvements in the manufacture of ink or writing fluids*."—December 31.

Charles Goughtly, of Gravel Lane, Southwark, Gent., for "*a new apparatus for obtaining motive power.*"—January 4.

George Child, of Lower Thames Street, Merchant, for "*improvements in the manufacture of bricks and tiles, part of which improvements are applicable to compressing peat and other materials.*" Communicated by a foreigner.—January 4.

John Swindells, of Manchester, Manufacturing Chemist, for "*improvements in the manufacture of artificial stone, cement, stucco, and other similar compositions.*"—January 6.

William Newton, of Chancery Lane, Civil Engineer, for "*certain improvements in looms for weaving.*" Communicated by a foreigner.—January 9.

John Rock Day, of Great Queen Street, Lincoln's Inn Fields, Sadlers' Ironmonger, for "*improvements in the construction of collars for horses and other draft animals.*"—January 6.

Henry Gunter, of Cullum Street, Fenchurch Street, Merchant, for "*improvements in preserving animal and vegetable substances.*"—January 6.

Henry Bessemer, of Perceval Street, Clerkenwell, for "*a new mode of checking the speed of or stopping railroad carriages under certain circumstances.*"—January 6.

William Thompson, of Upper North Place, Gray's Inn Road, Brush Maker, for "*improvements in the construction and mounting of various kinds of brushes and brooms.*"—January 8.

William Lacey, of Birmingham, Agent, for "*certain combinations of vitrified and metallic substances applicable to the manufacture of ornaments, and the decoration and improvements of articles of domestic utility and of household furniture, also applicable to church windows and shop lights.*"—January 11.

Matthew Uzielli, of King William Street, Merchant, for "*improvements in impregnating and preserving wood and timber for various useful purposes.*" Communicated by a foreigner.—January 11.

William Newton, of Chancery Lane, Civil Engineer, for "*improved machinery for cleaning wheat and other grain or seeds from smut and other injurious matters.*" Communicated by a foreigner.—January 11.

John Barwise, of Saint Martin's Lane, Chronometer Maker, and Alexander Bain, of 35, Wigmore Street, Cavendish Square, Machinist, for their invention of "*improvements in the application of moving power to clocks and time pieces.*"—January 11.

Thomas Harris, of Chiffnal, Salop, for "*an improved horse-shoe.*"—January 11.

Joseph Hall, of Cambridge, Grocer and Draper, for "*a seed and dust disperser, applicable to the freeing of corn and other plants from insects.*"—January 14.

Walter Hancock, of Stratford-le-Bow, Essex, for "*an improved means of preventing accidents on railways.*"—January 14.

Pierre Armand Le Comte de Fontainemoreau, of Skinner Place, Size Lane, for "*an improved machinery for carding and spinning wools and hairs, which he titles "Filo Finisher.*" Communicated by a foreigner.—January 14.

Melcher Gakner Todd, of the island of Saint Lucia, for "*a certain improved form of apparatus for the distilling and rectification of spirits.*"—January 14.

John Loach, of Birmingham, Brass Founder, for "*improvements in castors applicable to cabinet furniture and other purposes.*"—January 14.

William King Westley, of Leeds, Flax Merchant, for "*improvements in carding, combing, straightening, cleansing, and preparing for spinning hemp, flax and other fibrous substances.*"—January 14.

William Kenworthy, of Blackburn, Spinner, and James Bullough, of the same place, Overlooker, for "*improvements in machinery, or apparatus for weaving.*"—January 14.

Charles Cameron, Esquire, of Mount Vernon, Edinburgh, for "*improvements in engines, to be actuated by steam and other elastic fluids.*"—January 14.

Samuel Hall, of Basford, Nottingham, Civil Engineer, for "*improvement in the combustion of fuel and smoke.*"—January 14.

Alexander Jones, of King Street, London, Engineer, for "*improvements in the manufacture of copper tubes and vessels.*"—January 14.

Edward Foard, of Queen's Head Lane, Islington, Machinist, for "*an improved method, or improved methods, of supplying fuel to the fire-places or grates of steam-engine boilers, brewers' coppers, and other furnaces, as well also to the fire-places employed in domestic purposes, and generally to the supplying fuel to furnaces or fire-places, in such a manner as to consume the smoke generally produced in such furnaces or fire-places.*"—January 16.

John Ames, of Plymouth, Painter, for "*a new and improved method of making paint from materials not before used for that purpose.*"—January 16.

James Smith, of Deanston Works, Kilmadock, Perth, Cotton Spinner, for "*certain improvements in the preparing, spinning, and weaving of cotton, silk, wool, and other fibrous substances, and in measuring and folding woven fabrics, and in the machines and instruments for these purposes.*"—January 19.

Thomas Robinson, of Wilmington Square, Middlesex, Esquire, for "*improvements in drying woollen and other fabrics.*"—January 19.

Thomas Vaux, of Frederic Street, Gray's Inn Lane, Worsted Manufacturer, for "*improvements in horse-shoes.*"—January 19.

Caleb Bedells, of Leicester, Manufacturer, Christopher Nickell, of York Road, Lambeth, Gentleman, and Archibald Turner, Foreman to the said Caleb Bedells, for "*improvements in the manufacture of braids and plats.*" Partly communicated by a foreigner.—January 19.

John Barber, of Manchester, Engraver, for "*improvements in machinery, for the purpose of tracing or etching designs or patterns on cylindrical surfaces.*"—January 19.

Frederick Steiner, of Hyndburn Cottage, Lancaster, Turkey Red Dyer, for "*improvements in looms for weaving and cutting asunder double-piled cloths, and a machine for winding weft to be used therein.*" Communicated by a foreigner.—January 19.

John Cox, of Georgie Mills, Edinburgh, Tanner, for "*improvements in apparatus for assisting or enabling persons to swim or float, or progress in water.*"—January 19.

Charles Berwick Curtis, of Acton, Esquire, for "*methods to be used on railways for the purpose of obviating collisions between successive trains.*"—January 19.

Angier March Perkins, of Great Coram Street, Engineer, for "*improvements in apparatus for heating by the circulation of hot water, and for the construction of pipes and tubes for such and other purposes.*"—January 21.

John Melville, of Upper Harley Street, Esquire, for "*improvements in propelling vessels.*"—January 21.

William Hill Darker, senior, and William Hill Darker, junior, both of Lambeth, Engineers, and William Wood, of Wilton, Carpet Manufacturer, for "*improvements in looms for weaving.*"—January 21.

John Bradford Furnival, of Street Ashton, Warwick, Farmer, for "*improvements in the construction and application of air-vessels.*"—January 21.

William Cooper, of Layham, Suffolk, Iron Founder, for "*an improved method of constructing thrashing-machines and other agricultural instruments.*"—January 21; two months.

Isham Baggs, of Cheltenham, Gentleman, for "*improvements in printing.*"—January 23; six months.

Peter Fairbairn, of Leeds, Engineer, and William Suthill, of Newcastle-upon-Tyne, Flax Spinner, for "*improvements in drawing flax, hemp, wool, silk, and other fibrous substances.*"—January 26.

Edward Henshall, of Huddersfield, Carpet Manufacturer and Merchant, for "*improvements in making, manufacturing, or producing carpets or hearth-rugs.*"—January 26; four months.

Nathaniel Lloyd, of Manchester, and Henry Robotham, of the same place, Calico Printer, for "*improvements in thickening and preparing colours for printing calicoes and other substances.*"—January 26; six months.

Nathan Waddington, of Hulme, Lancaster, Engineer, for "*improvements in the construction of steam-boilers, and furnaces for heating the same.*"—January 26.

Cornelius Alfred Jacquin, of Huggin Lane, for "*improvements in the manufacture of covered buttons, and in preparing of metal surfaces for such manufacture, and other purposes.*"—January 26.

John Bradford Furnival, of Street Ashton, Farmer, for "*improvements in evaporating fluids, applicable to the manufacture of salt, and to other purposes where evaporation of fluids is required.*" Communicated by a foreigner.—January 26.

Richard Jenkyn, of Hoyle, Cornwall, Machinist, for "*improvements in valves for hydraulic-machines.*"—January 26.

William Gall, of Beresford Terrace, Walworth, Gentleman, for "*improvements in the construction of locomotive engines, and of the carriages used on railways, applicable in part to carriages used on common roads.*" Communicated by a foreigner.—January 28.

William Currie Harrison, of Newland Street, Eaton Square, Pimlico, Engineer, for "*an improved turning-table for railway purposes.*"—January 28.

Joseph Pryor, of Wendron, Cornwall, Builder, for "*an improved thrashing-machine.*"—January 28.

TO CORRESPONDENTS.

The drawing of a "Wood Bridge over the River Calder," will appear next month.

J. Cook *on the Curvature of the Arches of the Holy Trinity at Florence, will appear in the next Journal.*

We feel obliged to C. H. W. *for his communications; we will avail ourselves of them at an early opportunity; he will perceive that we have already taken advantage of one of them.*

We shall be happy to hear again from our Dublin correspondent.

H *in reply to* Eder *was received too late; it shall appear next month.*

We must apologize to several correspondents who have written to us for information, for not answering them; if they were aware of the numerous communications that are addressed to us, they would not be surprised at not hearing from us. If we are in possession of the information, without the necessity of going to others for it, we shall at all times feel much pleasure in answering their inquiries.

Books received too late for notice this month:—Trotter's Manual of Logarithms and Practical Mathematics; Architectural Precedents with Specifications and Working Drawings; Alderson on the Steam Engine; The Derby Arboretum.

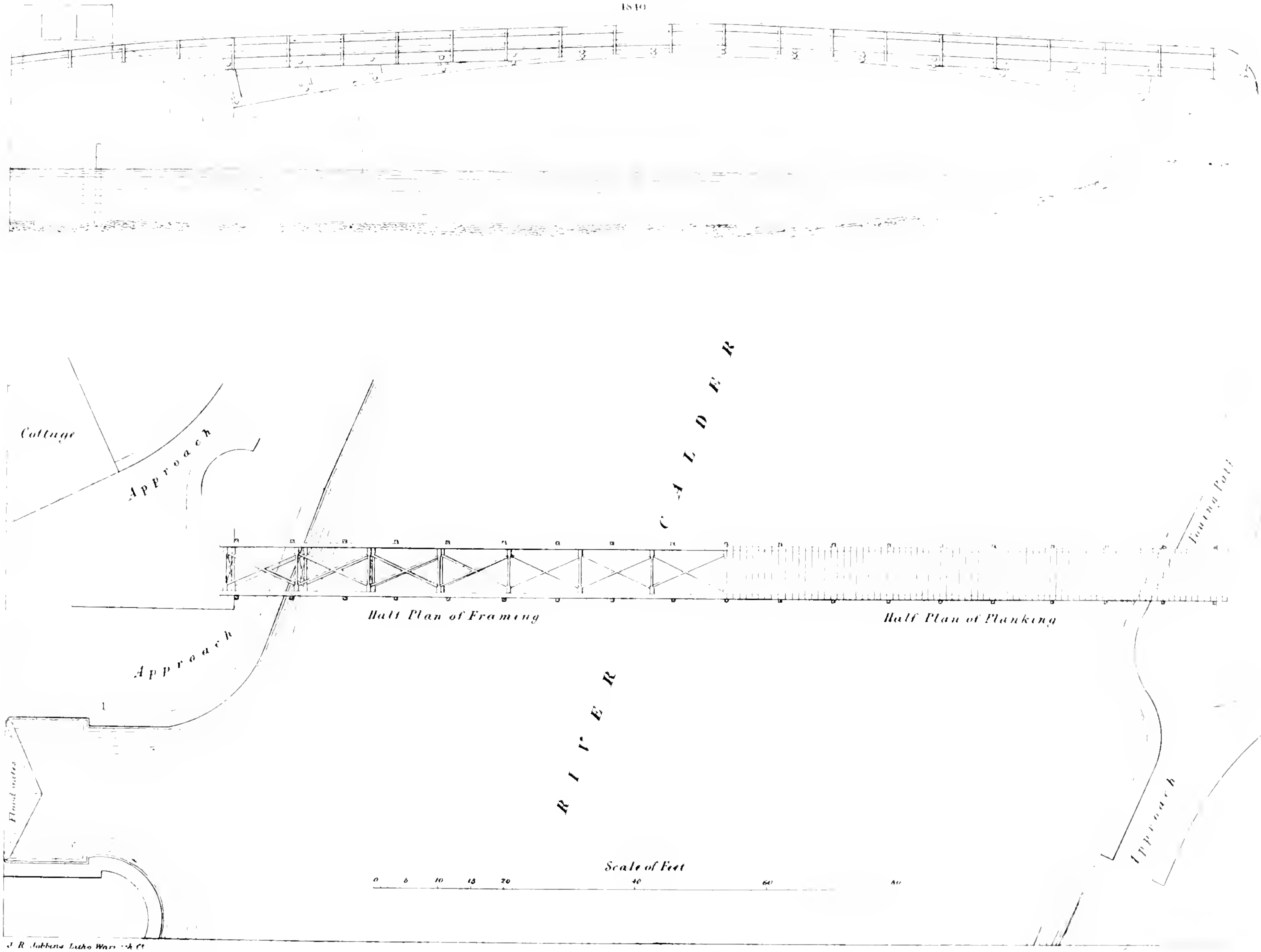
Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

By William Bull Civil Engineer.

1840



WOOD BRIDGE OVER THE RIVER CALDER, NEAR COOPER BRIDGE, YORKSHIRE.

For the use of the Hauling Horses on the Calder and Hebble Navigation. 1840.

(With an Engraving, Plate 3.)

William Bull, Engineer.

The span of this bridge is 150 feet, the versed sine of the arch 8 feet, and the width of the roadway 8 feet. The abutments are composed of solid masses of ashlar and rubble masonry. The arch consists of two ribs of fir timber with cross and diagonal framing pieces, as shown in the plan. The roadway is formed of 3 inch deal planks, over which is laid a coat of pitch, tar, and gravel mixed, and laid on hot to about one inch in thickness. The ribs are formed of two thicknesses of timber in pieces of about 21 feet long each, and laid on each other so as to break joint at each cross brace, where they are properly secured together by vertical and horizontal (cross) wrought iron bolts. The cross bolts having cast iron washers of about ten inches diameter at each end, and the vertical bolts, which are in pairs, are connected by two short straps of flat iron at the top and bottom of the ribs, the straps passing across the joints of the wood. The scantlings of the ribs are as follows: at the crown of the arch 2 ft. 2 in. by 9 in., at the abutments 3 ft. by 9 in. in two equal parts of 18 inches deep each, connected by vertical struts 13 inches by 6 inches, having the upright connecting bolts, one on each side of the struts.

The cost of the abutments, including the approaches at each side, which are made so that the horses can pass, first under, and then over, the bridge, so as to obviate the necessity of casting loose the hauling lines, was about £500, and of the arch about £170, making a total cost of about £1070.

The appearance of this bridge is extremely light and elegant, while the strength and stiffness is far more than adequate to the purpose for which it is intended.

The whole of the woodwork has gone under the Kyanizing process after it was framed, and is, besides, either tarred or painted.

THE DERBY ARBORETUM.

Fig. 1.—One of the Pavilions forming the Terminations to the cross Walk. Style of James I.

[It affords us much pleasure to be able to give the following description by Mr. Loudon of the Derby Arboretum, which was opened during last summer; it is the munificent gift of a private individual, whose patriotic example we sincerely hope will be followed by many other individuals. Mr. Strutt not only gave the land, but also engaged Mr. Loudon, one of the first Landscape Architects of the day, to lay out the grounds, and render them suitable to the purposes intended, which Mr. Loudon has done to the admiration and satisfaction of all parties.]

The situation is in the outskirts of the town; the extent about 11 acres; the form long, narrow, and irregular, as shown by the plan, fig. 2; the surface is flat, apparently level, but with a very gentle inclination from the north-east to the south-west; and the soil is loamy, on a gravelly or loamy subsoil. The situation is open, but not much exposed to high winds; water is to be found at the usual depth to which wells are dug, and there is one small pond which is never dry at any period of the year. Every part of the ground admits of drainage; but all the drains must terminate at the south-east corner, where alone the water can escape. The soil is particularly well adapted for the growth of trees, as is evident from the belt which surrounds great part of the grounds, and which was planted some years ago by Mr. Strutt. The most important feature in this piece of ground, with reference to its adaptation for a garden of recreation, is, that there is no distant prospect, or view beyond the grounds, worthy of being taken into consideration in laying them out; or at least none that may not, in a very few years, be shut out by the buildings of the town, which are increasing fast on every side.

The instructions given to me by Mr. Strutt respecting laying out this public garden were, that it was intended to be a place of recreation for the inhabitants of Derby and the neighbourhood, and for all other persons who chose to come and see it; that it should be open two days in the week, and that one of these days should be Sunday, during proper hours; and that on other days a small sum should be required from persons entering the garden; or yearly admissions should be granted for certain moderate sums. That the gardens should be so laid out and arranged as not to be expensive to keep up; that a flower garden and cottage, with the plantations already existing, should, if possible, be preserved; that a tool-house covered with ivy should also be preserved; that two lodges with gates, at the two extremities, should be built; and that each lodge should have a room, to be considered as a public room, into which strangers might go and sit down, taking their own refreshments with them, without any charge being made by the occupant of the lodge, unless some assistance, such as hot water, plates, knives and forks, &c., were required, in which case a small voluntary gratuity might be given. That there should be proper yards and conveniences at each lodge for the use of the public, apart from those to be exclusively used by the occupant of the lodge. That there should be open spaces in two or more parts of the garden, in which large tents might be pitched, a band of music placed, dancing carried on, &c. That certain vases and pedestals now in the flower-garden, and also certain others in Mr. Strutt's garden in Derby, should be retained or introduced; and, finally, that some directions should be left for the management of the garden.

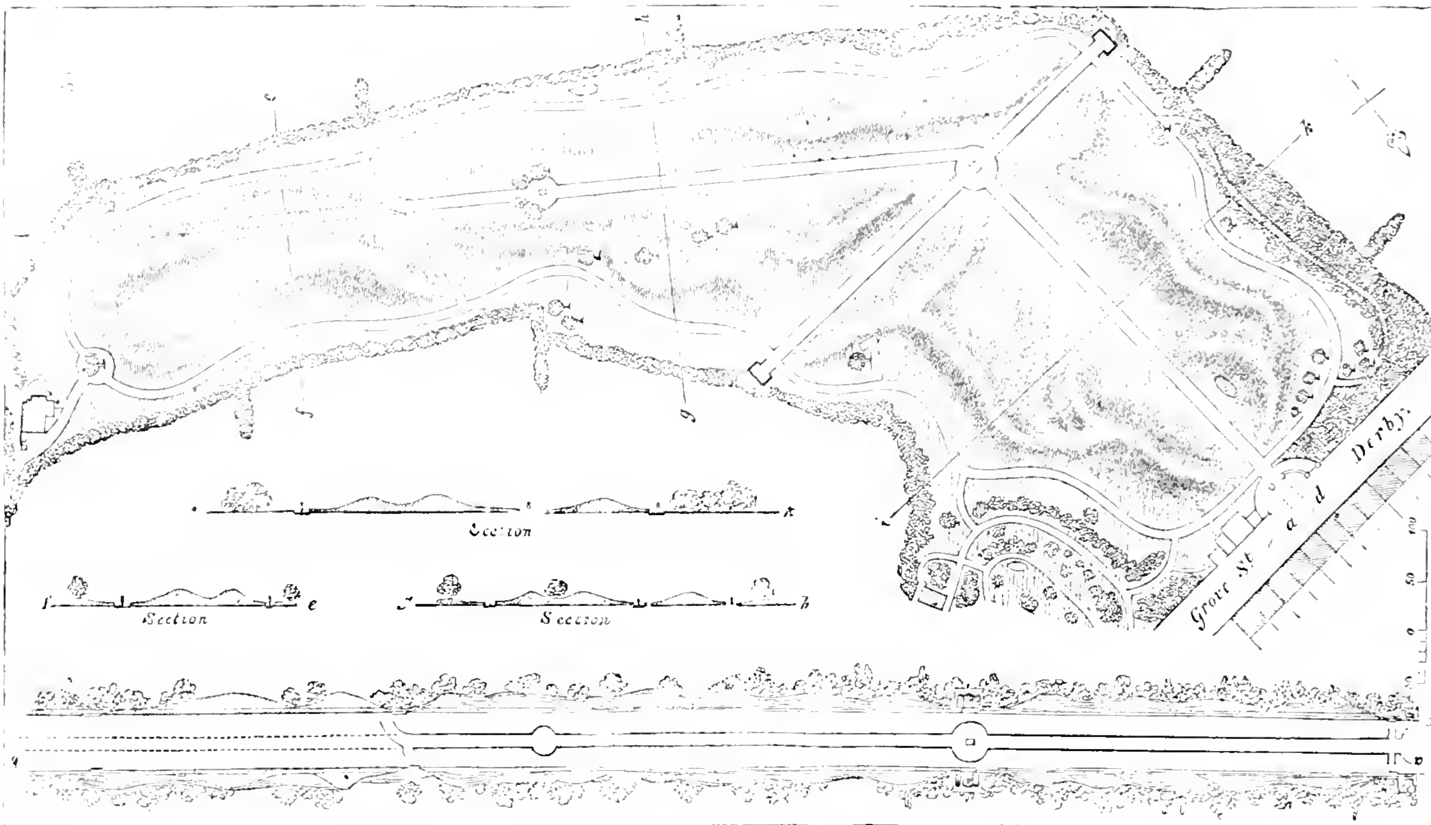
REASONS FOR THE MAIN FEATURES OF THE PLAN.

In endeavouring to accommodate the design submitted to Mr. Strutt to his instructions and to the situation, the first point determined on was, that the whole interest of the garden should be contained within itself. The mode of doing this was next to be considered; when it appeared that a general botanic garden would be too expensive, both to create and to keep up; that a mere composition of trees and shrubs with turf, in the manner of a common pleasure-ground, would become insipid after being seen two or three times; and, in short, that the most suitable kind of public garden, for all the circumstances included in the above data, was an arboretum, or collection of trees and shrubs, foreign and indigenous, which would endure the open air in the climate of Derby, with the names placed to each. Such a collection will have all the ordinary beauties of a pleasure-ground viewed as a whole; and yet, from no tree or shrub occurring twice in the whole collection, and from the name of every tree and shrub being placed against it, an inducement is held out for those who walk in the garden to take an interest in the name and history of each species, its uses in this country or in other countries, its appearance at different seasons of the year, and the various associations connected with it.

A similar interest might, no doubt, have been created by a collection of herbaceous plants; but this collection, to be effective in such a space of ground, must have amounted to at least 5000 species; and to form such a collection, and keep it up, would have been much more expensive than forming the most complete collection of trees and shrubs that can at present be made in Britain. It is further to be observed respecting a collection of herbaceous plants, that it would have presented no beauty or interest whatever during the winter season; whereas, among trees and shrubs, there are all the evergreen kinds, which are more beautiful in winter than in summer; while the deciduous kinds, at that season, show an endless variety in the ramification of their branches and spray, the colour of their bark, and the colour and form of their buds. Add also, that trees and shrubs, and especially evergreens, give shelter and encouragement to singing birds, to which herbaceous plants offer little or no shelter or food.

There are yet other arguments in favour of trees and shrubs for a garden of recreation, which are worth notice. Herbaceous plants are low, small, and to have any effect must be numerous; while, to acquire their names, and look into their beauties, persons walking in the gar-

Fig. 2—Plan of the Arboretum.



den must stand still, and stoop down, which, when repeated several times, would soon, instead of a recreation, become very fatiguing. Now trees and shrubs are large objects, and there is scarcely one of them the beauty of which may not be seen and enjoyed by the spectator while he is walking past it, and without standing still at all. A herbaceous plant is chiefly interesting for its flowers, and the form of its foliage, in which in general there is little change of colour; but, to these two sources of interest, trees and shrubs add the opening buds in spring, the colour of the expanded foliage immediately after it has burst from the bud, the fine green tinged with some other colour which the first leaves assume when they are fully expanded, and which continues more or less till the middle of June; the intensely deep green of summer, which continues till the end of July; the first changes of autumn to red or yellow, which commence in August; and the dying off of all the different shades of red, crimson, yellow, orange, brown, and purple, which continues taking place till Christmas; while some deciduous trees, such as the beech and hornbeam, the common oak in certain soils kept moist, and the *Quércus Taúzin* in all soils and situations, retain their leaves, after they have become brown, till the following May. There are also, in deciduous trees, the colour and bloom of the young shoots of the current year; the different colour which the bark of these shoots in many cases assumes the year following (*Sálix decípiens*, for example); and the colour and texture of the older shoots, and of the branches and trunk. In addition to these sources of interest, there is a very great beauty in trees, which, from the improper planting of artificial plantations, is often overlooked, or rather concealed; and that is, the ramification of the main surface roots at the point where they join the trunk. In general, trees are planted so deep that this ramification never appears above the surface, and the trunk of the tree seems fixed in the ground like a post which had been driven into it; an appearance as contrary to truth and nature, and also to the health of the tree, as the shaft of a column without a base or a capital would, if employed in a building, be to architectural taste. To prevent this monstrous and unnatural appearance from occurring in the Derby Arboretum, I have directed all the trees to be planted on little hills, the width of the base being three times the height of the hill, so that the junction of the main roots with the base of the trunk will appear above ground.

Much more might be said to justify the preference which I have given to an arboretum over every other kind of arrangement for the Derby Garden, but I consider any farther remarks on the subject unnecessary.

A glance at the plan, fig. 2, will show that I have provided as great an extent of gravel walk as he space would admit of; the total length, including the walk round the flower-garden, exceeding a mile. There is a straight broad walk in the centre, as a main feature from the principal entrance; an intersecting broad straight walk to form a centre to the garden, and to constitute a point of radiation to all the other walks; and there is a winding walk surrounding the whole. As a straight walk without a terminating object is felt to be deficient in meaning, a statue on a pedestal is proposed for the radiating centre in fig. 2; a pedestal, with a vase, urn, or other object, for the second circle in the straight walk, fig. 2; while the pavilions, (fig. 1,) form terminating objects to the broad cross walk.

As a terminal object gives meaning to a straight walk leading to it, so it is only by creating artificial obstructions that meaning can be given to a winding walk over a flat surface. These obstructions may either be inequalities in the ground, or the occurrence of trees or shrubs in the line which the walk would otherwise have taken, so as to force it to bend out of that line. Both these resources have been employed in laying down the direction of the surrounding walk, though its deviation from a straight line has chiefly been made in conformity with the varying position of the trees in the belt already existing. This belt, and also the trees in the flower-garden, and in other parts of the plan, which were there previously to commencing operations, and which are left conformably to Mr. Strutt's instructions, are shown in the plan fig. 2. The point of junction of one walk with another is always noticeable in an artistical point of view, and affords an excuse for putting down sculptural or other ornamental objects at these points; we have therefore placed Mr. Strutt's pedestals and vases in positions where, if they are kept properly supplied during summer with pots of flowers (the pot being placed in the inside of the vase so as not to be seen), they will form very ornamental objects; and, the names of the flowers being written conspicuously on a card, and tied round the narrow part of each vase, and the kinds of flowers changed at least once a week, they will be instructive as well as ornamental. The kinds of plants should be such as have conspicuous red or orange flowers, in order to contrast harmoniously with the masses of green foliage and grass with which they are surrounded.

All the walks are drained by semicylindrical tiles laid on flat tiles in

Fig. 3.—Interior View of the main Entrance to the Derby Arboretum. Style Elizabethan.

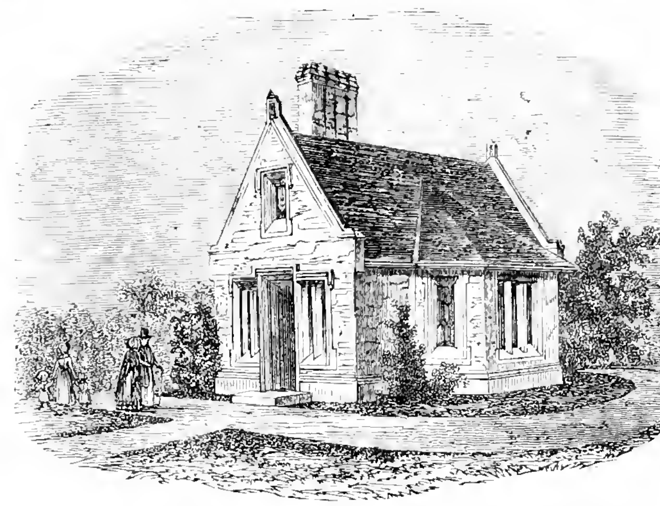


Fig. 4.—East Lodge of the Derby Arboretum, showing the public Room. Tudor Style, time of Henry VII.

a line along the centre of the walk, and by cross drains from this line to the edges of the walk, communicating with gratings fixed in stone at regular distances. There is nearly a mile of drains, and there are 150 cast iron gratings. The upper coating of gravel is of a good colour, brownish yellow; and, as when kept in proper order by rolling it binds very hard and smooth, the walks will be of the most dry, comfortable, durable, and agreeable description.

In order to disguise the boundaries of the ground, and to conceal the persons walking in the side walks from those in the centre walks, I have raised undulating mounds of soil, varying in height from 7 feet to 10 feet, in the directions indicated by the shadows in fig. 2; and these, even without the aid of the trees and shrubs which are planted on them, effectually answer the ends proposed. Certain spaces on the lawn throughout the garden are left perfectly smooth and level, on which tents may be fixed, or parties may dance, &c. I should have made certain hollows and winding hollow valleys, as well as the hills and winding ridges; but the retentive nature of the soil, the difficulty, or rather the absolute want, of drainage for such hollows, as well as the very limited space, and the necessity of having a broad, straight, nearly level walk down the centre, rendered this impracticable.

In moving the ground, care has been taken to preserve some of the old surface soil to form the new surface; and this new surface has also been drained where necessary, and every where rendered perfectly smooth and even, by raking and rolling, before sowing the grass seeds.

The seats have been designed and placed, chiefly by Mr. Strutt himself, reference being had to the following rules:—To make choice of situations under the shade of trees already existing in the belts, or of situations where some kind of view or feature is obtained; to place some in gravelled recesses along the sides of the walks, and others on the turf; some open to the sun for winter use; but the most part looking to the east, west, or north, for summer use. Those seats which are placed in recesses ought to be 1 foot back from the edge of the walk, in order that the feet of persons sitting on them may not be in the way of passers by; and the gravelled recess should extend 6 inches beyond the seat behind and at each end, for the sake of distinctness, and to prevent any difficulty in weeding the gravel or mowing the grass. No seat should be put down, along the walks, in such a situation as to allow persons approaching it to see the back of the seat before they see the front of it; and, hence, the seats should generally be placed in the concavities of the turns of walks rather than in the convexities of bends. No seat to be put down where there is not either a considerable space directly in front, or at an angle of 45°, or some other equal and large angle on each side. No seat to be put down where there will be any temptation to the persons sitting on it to strain the eye looking to the extreme right or left. None to be put down where more than one point of the boundary of the garden can be seen from the seat. None to be put down on the tops of the mounds, by which a person sitting would, at least before the trees and shrubs grow up, get a panoramic view of the entire garden, and thus defeat the main object of the mounds, and of the winding direction of the side walks. No seat to be put down, nor any device contrived, by which both the lodges can be seen at once from the same point of view; or even where one of the lodges and one of the pavilions can be seen from the same seat. Seats which are placed on the lawn always to be backed by some of the trees or shrubs there, so that no person may ever come close up to a seat from behind; or, if seats are placed in the open lawn without trees or shrubs near them on either side, then such seats must be made double, with a common back in the centre, or they may be benches without backs, or single seats, such as chairs or stools. All fixed seats, whether on the lawn or on gravel, to have foot-boards for the sake of aged persons and invalids. Round the central circle the seats should have stone backs, and a more architectural character than in any other part of the garden.

The flower-garden with its covered seat, the cottage in it with its public tea-room, and the ivied tool-house formerly attached to Mr. Strutt's kitchen-garden, are preserved; and also a a large weeping ash with seats beneath, the branches of which have been trained into a regular form by iron rings

In order to design the entrance lodges and gates, and the central statue, I called in the aid of Mr. E. B. Lamb, M.I.B.A., whose designs for the lodges and gates are shown in fig. 3, 4, and 5, and the ground plans of which are in accordance with Mr. Strutt's instructions in regard to public rooms, yards, and other accommodations. It may be added that the design of the garden will not be complete without an obelisk, or some such object, in the centre of the radiating circle in fig. 1; but this part of the plan is left to be completed by the committee of management.

As my instructions were to preserve as much as possible the belt and the trees in the interior of the ground already existing, I considered it most convenient to adopt the surrounding walk as a line of demarcation between the collection or arboretum in the interior of the grounds, and the miscellaneous assemblage in their circumference. Had the belt not existed, I should have extended the arboretum over the ground occupied by it, and thus have obtained room for a greater number of species, and a larger space for each individual tree and shrub. As things are, I have extended the belt in those places where it was wanting, and added to its interest by evergreen undergrowths, such as rhododendron, kalmia, laurustinus, box, holly, and mahonia; by low trees, such as arbor vitæ, red cedar, and cypress; and by large trees, such as cedar of Lebanon, silver fir, hemlock spruce, and evergreen oak. I have also introduced a collection of 100 different kinds of roses, all named; and placed the genera *U'lmus*, *Quércus*, *Pópulus*, and *Sàlix* in the new part of the belt, in order to give more room in the interior.

All the ground not covered by trees or shrubs I have directed to be laid down in grass to be kept closely mown; but round each tree and shrub forming the collection I have preserved a circular space, varying from 3 feet to 5 feet in diameter, which (with the hill in the centre, comprising one-third of the width of the circle, and on which the plant is placed) is not sown with grass, but is always to be kept clear of weeds. The use of this circle and little hill is to prevent the grass from injuring the roots of the trees while young, and to admit of the larger roots showing themselves above the surface, where they ramify from the stem, as before mentioned. It has been found since the garden was completed that these little hills have served as an effectual preservative of the plants; because, notwithstanding the many thousands of persons that visited the garden during the three days of the

Fig. 5.—East Lodge of the Derby Arboretum, showing the Entrance Gates. Tudor Style, time of Henry VII.

ceremony of the opening, not a single plant was injured. Some few of the shrubs which require peat soil, such as the heaths, have had that soil prepared for them; and the genera *Cistus* and Heliánthemum, which are apt to damp off on a wet surface, are planted on a raised mass of dry rubbish, covered with stones. All the climbing plants have upright iron rods, with expanded umbrella-like tops, placed beside them; the lower end of the iron rod being leaded into a block of stone, and the stone set in mortar on brickwork, so that the upper surface of the stone appears 1 inch higher than the surrounding surface. This appearance of the stone above the surface is not only more architectural and artistical, but better adapted for the preservation of the iron at the point of its junction with the stone, than if the stone were buried in the soil.

With respect to the annual expense of keeping up the garden, it will be evident to those who have seen it, or who understand this description, that it will chiefly consist in mowing the grass in the summer season. As the extent of grassy surface to be mown will be reduced by the space occupied by the walks, and by the circles of earth on which there is no grass (on which the trees and shrubs stand, or which those in the belt cover entirely), to about six acres, one man will be sufficient to mow and sweep up this extent of lawn during the whole summer; the daily space to mow being about half an acre, and the grass mown to be distributed over the naked circles on which the trees and shrubs stand. All the other work which will require to be done in the garden during summer, such as weeding the walks, rolling them, weeding the circles on which the trees and shrubs stand, picking off insects from the plants, watering the ground with lime water where worm-casts appear, wiping the seats every morning so as to remove the excrement of birds, or whatever leaves or other matters may drop from the branches of the trees over them, &c. &c., may be accomplished by a second labourer. The head gardener or curator may manage the flower-garden and the vases of flowers at the junctions of the walks, and see that the company who walk in the garden do not injure the plants, &c.

During the winter season, or from December 1, to May 1, more than one labourer in addition to the head gardener will be unnecessary. The second labourer may at that season, therefore, be allowed to retain his house, and seek for labour elsewhere; and the saving thus made, it is presumed, would be a contribution towards the purchase, from some of the Derby nurserymen or florists, of all the flowers or other plants that may become necessary to fill the vases from May till October. Unless some arrangement of this sort be made, it will be impossible to do justice to the plan of exhibiting plants in the vases; because the flower-garden, if made a source of supply, would be injured in appearance; and to have a reserve garden, with a green-house or pit, would involve much more expense than hiring the plants from a nurseryman, and would be far from attaining the object in view so effectually. On the supposition that there were fifty vases, there would then be fifty different kinds of named flowers or green-house plants in them every day during the summer; and supposing that these kinds were changed once a week, and the same kind not repeated more than once in the same season, there would then have been upwards of 500 different kinds of handsome plants, with their names attached, exhibited to the public in the course of a single year. To give an idea of what these plants might be, I shall suppose them to consist of 200 showy hardy and tender annuals, 100 dwarf dahlias, 100 choice herbaceous plants, 100 geraniums, 100 Australian plants, 50 heaths, and 50 miscellaneous green-house plants, including fuchsias, cacti, aloes, &c. One great use of these plants is, by their bright red, yellow, orange, or white colours, to relieve the eye, and form a contrast to the green of the foliage and grass with which they are surrounded on every side. A similar contrast will be obtained by the colours of the dresses and countenances of persons walking in the Arboretum.

The plan of the Arboretum was made in May, 1839; and, being approved of by Mr. Strutt, as soon as the crop of hay was removed from the ground, in the July following, the work was commenced by Mr. Tomlinson, a contractor for ground work, who laid out the walks, made the drains, and raised the general masses of the mounds. The mounds were afterwards moulded into suitable shapes, and connected by concave sides and lateral ridges with the surrounding surface, under the direction of my assistant, Mr. Rauch, who also superintended the planting of all the trees and shrubs, and all the other details connected with the ground, till the completion of the whole in September, 1840. The trees and shrubs were supplied chiefly by Messrs. Whitley and Osborn, but partly also by Mr. Masters of Canterbury; and the miscellaneous collection of roses was furnished by Mr. Rivers of Sawbridgeworth; the mistletoe was supplied by Mr. Godsall of Hereford; and some species, which could not be procured in the nurseries, were obtained from the Horticultural Society's Garden. The lodges and pavilions were designed by Mr. Lamb, as already mentioned: the north, or main, lodge in the Elizabethan style; the east lodge in the Tudor style, and in that variety of this style which was prevalent in the time of Henry VII.; and the pavilions in the style of James I. They were all built by Mr. Thompson of Derby; and the gates to the north, or principal, lodge were cast from Mr. Lamb's designs by Messrs. Marshall, Barber, and Co., of Derby.

ARCHITECTURAL COMPETITION.

Sir—The spirited manner in which you acted respecting the proceedings of the Gresham Committee in their attempt to extort the sum of one pound from architects desirous of competing for the Royal Exchange, and for which you received a vote of thanks from the Manchester Architectural Society, in which I (being a member) heartily concurred, has induced me to forward you the enclosed advertisement, which appeared in the Times newspaper, in compliance with which I wrote to the Vicar for the necessary particulars, and received in answer the accompanying note, by which it appears that the Vicar and Churchwardens are following the notable example of the Gresham Committee. Surely if the demand of twenty shillings for the necessary instructions was an extortionate act of the Gresham Committee, how much more so is the same demand in this case, where even the successful competitor is only to receive his commission upon £1,000, instead of the much larger sum at stake in the case of the Royal Exchange.

I leave you to comment upon this subject (should you think it worth notice in your valuable Journal), in any way you deem proper, but I think you will agree with me that the practice of charging architects *anything*, be the sum either large or small, for the instructions necessary in the preparation of competition designs, is very impolitic and reprehensible, and one that ought to be most strongly protested against by the profession.

The loss of time and expense architects must necessarily incur one would imagine quite sufficient for the most exacting Committee, without having new burdens continually heaped upon them.

I am, Sir,

An occasional Competitor.

February 8, 1841.

The following is the advertisement and letter referred to by our correspondent:—"Architects desirous of submitting plans for the new pewing of the church of Fordingbridge, Hants, may apply to the Vicar and Churchwardens of Fordingbridge, until the 16th day of January next."

"The Vicar and Churchwardens in reply to A. B.'s letter, beg to inform him that the plans for repewing the Church of Fordingbridge, must be sent in by the 26th of February, and be in strict accordance with the instructions of the Church Building Society, but the estimate must not exceed £1,000.

"A lithographic ground plan is now ready to be forwarded on the remittance of a Post-office order for £1.

"A motto must be inscribed on the plan, and also a sealed letter enclosing the name of the candidate."

Fordingbridge, Jan. 20, 1841.

EPISODES OF PLAN.

"*Tædet quotidianarum harum formarum.*"

That there should be any thing at all novel in our manner of treating the subject we have chosen,—that the same idea should not have presented itself to others, and have been frequently adopted and carried out in publications bearing upon the particular branch of architectural study towards which this series will, we trust be found to contribute something fresh,—that such should be the case causes us no small surprise. Yet that we have not been anticipated in our present task by any one else, we may venture to affirm with tolerable confidence, since in none of the architectural works, either English or Foreign, we have seen—and our acquaintance with them is tolerably extensive—have we ever met with any studies of the kind we here purpose bringing forward. Nay the subject itself, as regards *Plan* generally, is almost invariably passed over without the slightest remark of any kind, as if either it were altogether unimportant in respect to design, contrivance, and effect: or as if the merits and defects, the advantages or disadvantages arising out of it were so exceedingly obvious to every one as to render it quite unnecessary to call attention to circumstances of that kind. In regard to Plans it is thought quite sufficient to give the mere explanatory *references* to them, without any thing farther even in the way of descriptive remark: much less are they ever accompanied by any thing like critical examination and comment. The Vitruvius Britannicus and similar works are so far altogether dumb books to the student, leaving him entirely to his own discernment and application, without even so much as putting him in the way of properly and profitably exercising them.

For this neglect of what deserves quite as much attention as almost any thing else in architecture, the only excuse that can be alleged—and a most unsatisfactory and provoking excuse it is—is that the plans themselves are so exceedingly common-place and insipid as scarcely to afford any matter at all for remark. We can learn from them the number and dimensions of the rooms, and beyond that there is very rarely any thing whatever in a plan that claims particular notice: for scarcely ever do we meet with a single piquant and *effectful* Episode. As seldom, too, do we find aught very original or particularly happy in the general combination—in what may be called the *laying out* of a building, generally. Instead of perceiving diligent study in this respect, we far more frequently detect—or rather, are struck by defects that seem to have originated in sheer negligence and inattention, they being such as could hardly ever have been suffered to pass, had the drawings been duly revised and reconsidered for the purpose of ascertaining whether they were susceptible of improvement. Laugier's remarks as to the extreme importance and value of Plan, are so excellent that they ought to be written in letters of gold, and hung up in every school of architecture,—certainly to be noticed in every elementary course of the study; and yet the advice they contain is either unknown or disregarded, which circumstance is rather a discouraging one to ourselves, inasmuch as it indicates what little attention is paid to, or interest is taken in what we have here selected as our subject.

Another writer, Milizia, reproaches architects with the monotonousness of their plans, and with scarcely ever deviating from the most "quotidian forms." With here and there a solitary exception, as he remarks, all our rooms—the most sumptuous as well as the most ordinary ones—are rectangular both in plan and profile; that is, are spaces enclosed only by four walls, and covered by a flat ceiling; consequently variety is reduced to little more than that which can be obtained by means of size and proportion, in regard to which there can be comparatively little difference in any suite of principal apartments in a house. For diversity of character, therefore, rooms are, in general, made to depend solely upon fitting-up, decoration, and furniture—matters which, as usually managed, are hardly considered to belong to the architect's province at all. In regard to what is strictly understood by the architecture of a room, variety of design seldom extends beyond what may be called mere *pattern;* the general forms being in every case the same, let them differ as they may in regard to detail. We are far from denying that considerable difference of character is attainable even according to the usual practice; but then it is obvious that such difference might be increased in geometrical ratio, by adopting forms that would lead to an infinity of combinations.

The system hitherto pursued in laying out—not ordinary houses, but mansions where we might expect to meet with all the graces of interior architecture, is calculated to produce only the minimum of effect; and what little effect it admits of is generally misplaced, being bestowed not on the apartments themselves, but merely on the approach to them. Far more frequently than not, such parts as entrance halls and staircases are both more spacious and more striking—both more architectural and more picturesque than any others; and in comparison with them, the rooms to which they lead, seem quite commonplace—not to say insignificant.* The consequence is, a most unfortunate anti-climax. That the first coup d'œil on entering should be a favourable one, and impressive in itself, we readily grant; still what is so shown should be treated as only preparatory—as something intended to excite curiosity, and not as a magnificent promise followed by nonperformance and disappointment. There ought at least to be something of equal value kept in reserve, so as, at any rate to keep up a balance, if no more; whereas the contrary mode may not inaptly be described as a sort of bathos in architectural composition,—as the reverse of a *crescendo* effect,—as a most disagreeable and provoking, because disappointing, hysteron-proteron.

Before proceeding further, it may be as well fairly to meet, knock down, and put *hors de combat* at once those objections which, we foresee, are likely to be brought against the system we ourselves advocate, unless we can show that so far from having overlooked, we have considered, and are prepared to meet them. In the first place it may be urged with some degree of plausibility that if the kind of monotony and sameness which, together with Milizia, we hold to be a defect, were really felt to be such, and on the other hand, the picturesqueness and variety arising out of circumstances of plan and section, were positive merits, pains would be taken to secure the latter, and avoid the former. To this we reply; the constant repetition of the same hackneyed, commonplace forms is looked upon as matter of course: people in general are quite reconciled to it, because they neither look for, nor have any idea of what may be produced by a different mode of treatment. Besides which, the defect is rather negative than positive: a room is not faulty because it is "*quotidian*" in form, and there is nothing particular in it as to design, or that distinguishes it from a thousand others; the fault complained of is, that by confining ourselves to a single idea, as it were, we completely forfeit all those varied effects of which we might avail ourselves. Nor can it be said that the architectural picturesqueness arising out of plan, and general arrangement, is not worth the study it demands, because we have ever found that where it has been produced, it has always struck every one, and made a far greater impression upon them, than mere decoration, however costly. Granting that nothing whatever is gained by it in point of convenience, comfort, or accommodation,—and that a room of the most ordinary shape may be fitted up and furnished quite as splendidly as one which is striking on account of its architectural design;—what then? if any argument against our view of the case is to be derived from that, it may be extended so as to be applied with equal propriety against beauty of proportions in a room, for neither does that conduce to convenience or comfort, nor does the want of it prevent display being made in decoration and furniture.

It will be said, however, that such unusual—or as they will be called very *out-of-the-way* forms as are some of those we intend to bring forward in the course of the present Essay, would be found expensive in execution—perhaps be attended with loss of space, and would hardly admit of being applied without sacrificing other parts of the plan. That they would be more expensive is not disputed: therefore where economy is to be consulted quite as much—if not more than effect, they are of course out of the question; yet on that account they are no more open to censure or cavilling, than porticoes and many other things in architecture, which being of no positive—at least of no urgent utility, may be dispensed with where their cost becomes a serious consideration. It may further be frankly conceded on our part, that to introduce into a plan such features as our Episodes, would demand much more study and contrivance than is required when all that is to be done is to divide it into a given number of squares or parallelograms for the different rooms. To those who complacently satisfy themselves with doing that, and who consider any thing further no better than superfluous *trouble*, no ideas but those of "quotidian" routine are likely to present themselves, let the opportunity for introducing others be as favourable as it may. Hence, we rarely meet with any novelty—or aught striking, in regard to the plan, except in peculiar and obstinate cases, where, owing to local difficulties or other circumstances, the architect has been obliged to humour them, and has thereby been actually compelled to deviate from the ordinary track, and adopt by way of expedient what he would neither have done nor thought of doing, through choice.† Without premeditation, and being brought

* We were lately consulted as to a plan for a very extensive mansion about to be erected, where, on immediately entering the house the visitor sees before him a grand architectural vista of about 300 feet in length,—a most imposing display, no doubt, but produced at the cost of all the rest, for all the rooms would appear little better than cabinets in comparison with it. We accordingly suggested that it would be an improvement, to make a moderate sized entrance vestibule, and reserve the other part as a grand gallery coming at the termination of the suite of reception and drawing rooms.

† It may very fairly be questioned whether the interior of Windsor Castle

in for the [illegible] unusual forms and arrangements are not at all likely to present themselves:—yet a single idea of the kind once adopted readily suggests a second and a third: for the combinations thus to be produced are so illimitable, that the chief perplexity is to decide which of them deserve the preference.

Occasionally, indeed, one meets with plans intended to display novelty and ingenuity, but then so far from being calculated to prepossess in favour of their forms and arrangements, they are seldom better than mere architectural *capriccios*, compounded of extravagant and absurd whims,—merely oddities, in which but little regard is paid either to effect or convenience, consequently they chiefly serve to bring every thing of the kind into discredit, and to confirm the prejudice in favour of common-place routine. Novelty alone will not suffice: there must also be something that will preserve its freshness and will continue to charm when the interest occasioned by novelty shall have worn away.

We are aware there are some who affect to despise any thing like contrivance or scenic effect in architecture, as beneath the dignity of the art—as partaking of stage trickery—as liable to be paltry. They insist upon simplicity, and nothing but simplicity, as if picturesqueness and complexity were never to be admitted, but banished altogether as faults. "Intricate forms, in works of architecture," Professor Hosking tells us, "whether *internally* or externally, will be found unpleasing:" and undoubtedly he is right, if he means no more than to censure that degree of intricacy which becomes confusion—a perplexed architectural jumble that wearies the eye by presenting no one distinct picture, instead of presenting a series of them—all varied, yet all agreeable in themselves and skilfully combined. Most certainly it is not easy to draw a precise line between what is an allowable species of intricacy, and what becomes a faulty excess of it. Yet if no positive rules can be laid down in regard to that quality in architecture, neither can it be done in regard to simplicity, which is apt to be carried so far that it becomes nothing better than poverty, baldness, monotony and insipidity. This is a misfortune which must be patiently submitted to; though, for our own part, we question its being one at all; since there would be small merit in going right, if it were impossible to go astray; nor would, we apprehend, the dignity of art be consulted by reducing art to such a system of exact rules for every possible occasion and contingency, that it might be learnt by rote. Of mechanical rote and routine there is by far too much in architecture already. It is true routine must be learnt and gone through: yet that is no reason wherefore we should confine ourselves to it without endeavouring to get a step beyond it. Rules are excellent leading-strings for beginners, yet little better than shackles to the more advanced artist.

(To be continued.)

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXIV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. The terms in which they are sometimes spoken of, might lead those who had never seen them, to imagine that our London Squares possessed a high degree of positive architectural beauty, or at least were strikingly picturesque: neither of which is by any means the case. To apply, as has been done before now, the epithet "magnificent" to them, might almost pass for malicious, sneering irony, did we not know that if not bestowed, out of serious conviction, it is at least intended to be understood in earnest;—and such prodigality of praise, most certainly costs the dealers in "flummery" description nothing, it being just as easy to write the word "magnificent" as any other. The sober truth is, our Squares are very agreeable places of residence, and the houses in them are generally of a superior kind to others in their neighbourhood; they are more pleasantly situated, enjoy more light and air, and also a comparative degree of quietness. But as to architectural effect of any kind, that must not be looked for, there being no more in the elevations which form such *places* than in the sides of the streets of private houses, which lead into them. Here and there, it is true, there may be a front which possesses greater pretensions than its neighbours: but the same may occur in any other range of houses. Our Squares have an air of opulence and comfort, that is not to be mistaken: but they are quite in architectural undress, certainly not in gala costume,—in superfine broad-cloth, if you will, yet as plain and homely in cut, as if it were drugget. Now we do not say that this is wrong,—on the contrary, we hold such unpretending plainness to be more respectable than tawdry vulgar finery: all we wish is to call things by the right names, and not to talk of "magnificence" where it exists no more than in the garb of a Quaker. Let us leave to such persons as George Robins the humbugging practice of *dignifying* ordinary things by superfine words, unless we choose to be at the trouble of inventing other commendatory epithets to supersede the present hackneyed ones; for at present, those of "magnificent," "grand," "elegant," &c., are so bandied about on every paltry occasion that they have lost all force and meaning, and are in no better repute than the term "respectable." In honest truth, if we look at them with an architectural eye, the character of our Squares is only insipidity. They present neither the charm of piquant variety and contrast, nor that of unity of design. They are nothing more than four ranges of buildings surrounding an open space with a garden in its centre; consequently the *totality* of the design—supposing there to be any design at all—is lost, because the correspondence existing between those separate elevations is hardly distinguishable to the eye. Belgrave Square forms no exception, for even there, owing to the size of the area or *place* itself, the houses—which, by the by, are far from being in the most dignified style, or very best taste—appear low by comparison with it. The elevations produce no collective effect:—the four make no greater architectural impression than a single one of them would do in the same situation; while, on the other hand, if each is considered by itself as a single separate façade, it is very unsatisfactory, because there also we find proportion disregarded, and all grandeur nullified by the multiplicity of small parts.

II. Except what is called the Circus in Piccadilly, and in Oxford-street; and what is called the Polygon in Somer's Town, we have no instances of *places* that are round or polygonal in their plans,—none that are either hexagonal or octagonal, notwithstanding that those forms are well adapted for such purpose in themselves, and would create some variety in our street scenery. Upon a large scale the elliptic shape would be found applicable, and in such case the street might run through it in the direction of its transverse axis. An oval *place* of the exact dimensions of the Flavian Amphitheatre or Colosseum, viz. one whose axes should be 615 and 510 feet respectively, with a garden in the centre, of the size of the arena, would convey a better idea of the vastness of that monument, than Lincoln's Inn Fields do of the Great Pyramid. But to produce its full effect, no such place, be it an ellipse, circus, crescent, or polygon of any kind, should have its circumference broken by being pierced with streets running into it; for it ought to be entered through arches or gateways, over which the elevation should be continued. The Circus in Oxford-street, is no circus at all, but presents merely four segmental slices of one, separated from each other by exceedingly wide streets.

III. It may very fairly be suspected that the new Professor of Architecture at the Royal Academy is not at all likely to gain much credit by the remarks he threw out the other evening, in disparagement of Gothic Architecture. Most assuredly they did not betoken those enlarged and comprehensive views of art which ought to qualify one who fills so important and influential a post, and whose opinions will of course be received with implicit deference by many, and without further questioning or examination. On the contrary they were hardly worthy of a village pedagogue, much less of a Professor of the art. To adopt them, would be to retrograde instead of advancing,—to return to the now exploded prejudices against the Gothic style, which led such writers as Evelyn to condemn it as "a monkish and gloomy" mode of building, wherein no sort of harmony or correctness of proportions is observed! If the Professor be right, all we have been doing for the last forty or fifty years in regard to the study of Gothic architecture, has been worse than useless—positively naught and mischievous, seeing that the sooner we now unlearn it and retrace our steps, the better. It is a pity the Professor was not placed *in cathedra* a few years sooner, for in that case, we should probably have been spared the mortification of seeing the style denounced by him adopted for the new Houses of Parliament. It is further to be regretted that he did not think proper to explain himself by pointing out in detail the defects of the Gothic style *per se*, and what it is that renders it wholly inapplicable—at least unworthy of being applied, at the present day. By not doing so, he has afforded ill-natured people, the opportunity of saying that it was not in his power to support his opinion by aught of argument; consequently, that though it comes from a

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would have had so many picturesque circumstances in its plan as at present, had its architect been employed to erect an entirely new structure, instead of altering and enlarging the old one. We doubt it; in that case, we should have had such unusual forms and combinations—such piquant *Episodes of Plan*, as the Library formed out of Queen Elizabeth's Gallery, the Waterloo Chamber, and the Breakfast Room at the angle of the two branches of the Grand Corridor.

Professor, it is no more than a bare opinion—a sweeping sentence of bigotted taste, put forth with authority, and seeking rather to silence contradiction than to convince. Fortunately such bigotry is perfectly harmless—likelier by far to excite ridicule, and laughter at the learned Professor's expense, than to prove mischievous by putting us out of conceit with Gothic architecture, and reviving the exploded half-witted prejudices against it. It is odd the Professor should not have seen this, and felt that if he touched upon the subject at all, it became him to do so boldly, that being the only effectual and proper course. At present, it looks as if he was fearful of saying too much,—that is, supposing him capable of vindicating his dogmas of taste. Vague assertion, even though it may proceed from a Professor, is but vague assertion after all; nor would it matter a single straw of itself, were it not that many receive it without further inquiry as an authorative *ipse dixit*, against which there is no appeal:—not however, that such is likely to be the case in the present instance, for we believe that the majority of the Professor's auditors were disposed to contradict him point blank. Mr. Grellier, who fancies "one man's Gothic is quite as good as another's," and one or two others may probably rejoice at finding the taste for Gothic architecture reprobated *ex cathedrâ* at the Royal Academy; but should the matter come to the ears of Mr. Welby Pugin, he will perhaps take up his cudgels again, and flourish them so stoutly as to make the poor Professor cry out "*peccavi.*" Now had the Professor manfully thrown down the gauntlet to Pugin, by formally controverting all that the latter has urged in favour of the Gothic style, it would have been doing something—would have been consistent and to the point. But what avails it to let off a puny little fizgig of a squib against Gothic architecture, instead of battering down the rampart of prejudices by which it is now defended? It is like attempting to knock down a citadel with a popgun.

IV. I frankly confess I do not at all comprehend Mr. Rooke's *sublimities*, nor can I make out what is the standard of Architectural Beauty to which he would refer us. However it is to be hoped that all are not so dull as myself, and will therefore be able to understand and turn to account what seems to have been dictated by the Great Sphynx herself. All that I can gather from his long rigmarole of words is, that Mr. Rooke not only admires, but actually venerates Gothic Architecture, and is therefore not likely to venerate such decriers of it as the present Professor of Architecture, and Mr. Grellier. Let Rooke then take the Professor to task, for it is certain that if he can neither convince nor convert him, he will fairly bamboozle him,—unless the Professor be Œdipus himself.

V. It is to be regretted that we have scarcely any documents at all to assist in studying or forming an acquaintance with the modern architecture of Spain and Portugal. In general, I suspect, it is but in very indifferent taste; nevertheless there must be something worth notice, if only as specimens of the national style. The Spanish and Portuguese architects, however, appear never to have published any of their designs, nor has that task been undertaken for them by foreigners—by any of those artists who have of late years afforded as tasteful studies of Italian and Sicilian architecture. Without going further, there must surely be enough at Madrid alone, to furnish materials for such a work as Gauthier's on Genoa, or Grandjean and Famin's Architecture Toscane.

THE ARCHITECTURE OF LIVERPOOL.

Sir—Having once undertaken to reply to the criticisms of your correspondent Eder on the above subject, I hope, since he has proceeded with his remarks, that you will again favour me with a portion of your space for the continuation of my rejoinder. I wish it may be understood that I pursue this system of counter-criticism from no love of controversy, but with a view to setting the architectural merits of the buildings noticed in their true light, so far as my poor ability may extend. It appears to me that your correspondent often overlooks the leading defects of the buildings he criticises, and expends his severity on their minor, though, perhaps, to the generality of observers, more obvious faults; and on the other hand, sometimes withholds all praise where much is really deserved. In speaking of the Royal Bank Buildings, he exclaims against the extravagant use of ornament in certain parts, but says nothing of its uniform coarseness of design, and utter want of meaning and character. He condemns the height of the basement and balustrade in the street front, but seems not to have observed, and a most singular oversight it is for an architectural student, that the front of the Bank itself facing the court, is composed of a Grecian Doric, and Ionic order, one above the other, and with so ærostyle an amount of intercolumniation, that I could not forbear laughing outright on my first encounter of its mirth-provoking visage; but reflecting that some £30,000 had been expended in producing all this tawdry deformity, I acknowledged to myself that, like Bottom's comedy, this was "very tragical mirth." The Venetian windows on the ground floor of the street front, consist of a little bit of Grecian Doric entablature with two columns and antæ, set on a sill which, with its burden, overhangs the wall beneath it, like that of an ordinary brick house. But enough of this most "original" edifice. Let us follow Eder to the Town Hall. He says it is "highly creditable for the day when it was executed," and in truth, nothing nearly so good has been executed in Liverpool since; it was originally designed by Wood, of Bath, though it has received later additions, (of the past generation,) which have in one or two respects improved it; still the original merit is his. When Eder condemned, with some justice, the carvings between the capitals, which, however, by no means obtrude themselves on the eye so as to become serious blemishes, he might, I think, as a set-off, have noticed the graceful well-conceived figure of Britannia by the late Charles Rossi, R.A., surmounting a cupola, which, though not adhering in its columnar arrangement to the strict rules of Grecian propriety, so often quoted and expatiated on by those who are utterly incapable of making any practical application of their principles, has the merit—and possibly, with deference be it said, the preferable one, in a structure in the Italian mode, and of its moderate dimensions—of a varied, picturesque outline, with perhaps some intricacy of form, but certainly much originality of design. It is, in fact, one of the most pleasing and characteristic features out of many which rear themselves above the ordinary buildings of the town. As regards the Railway station, we shall not materially differ, though I must observe that the capitals of the Corinthian columns are notoriously bad, whether the fault of the design or execution I know not; and that this ugly screen hides one of the best trussed roofs of a large span with which I am acquainted.

I cannot, nor I imagine could most persons, accede to the opinion that St. Luke's Church is a most successful attempt in the Gothic, or rather, the pointed style. The exterior is certainly fine in execution, of an excellent material, and often beautiful in detail; but as a whole, I confess I cannot admire it as some others do. Firstly it wants a clerestory, which gives an appearance of disproportionate height to the tower, and a want of importance and character to the body; and in the next place, the tower itself is far too much of a parallelogram, in which defect I think this church shares with its name-sake of Chelsea, arising, in both cases, from the use of octagonal turrets in lieu of buttresses, of which practice, as applied to a western tower, I have never seen an instance in which the effect was good. I do not extend this opinion to the central towers of cross churches, or Lincoln Cathedral would at once refute me: perhaps the western towers of the same edifice may be quoted against me: but be it remembered, that in this instance a screen wall extends north and south, and gives that air of stability to these towers which they would otherwise want. I must acknowledge they were never entirely satisfactory to me, even as they are. The fine colour of the stone and height of the tower, make this church a fine study for effects of ærial perspective: especially when the pinnacles and turrets of the body and chancel appear in front of the more distant tower, in hazy weather; but while, in this respect, as well as a beautiful specimen of detail, and a fine piece of masonry, I admit the merits of this church to the full, I am of opinion that Mr. Gandy, to whom the design is ascribed, has failed to produce a striking example of the style. The want of a clerestory mars the effect of the interior, and the ceiling of the nave is quite out of character with those of the aisles. A rich wood roof was, it is said, designed for this church, but misdirected economy substituted one of lath and plaster. I can refer Eder to a modern church tower within three miles of Liverpool, which, though on a smaller scale and of an inferior material to this of St. Luke's, is equally good in detail, and in proportion and effect much superior. I allude to that lately added to the parish church of Walton, in which the architect, Mr. Broadbent of this town, has proved that he feels and has imbibed the true spirit of the style in which he worked.

Your correspondent next notices the North and South Wales Bank, in which he says the architect has encountered and overcome "enormous difficulties." Now really I must be permitted to say that I think the difficulties had the best of the battle. The ground is contracted for the accommodation required, and to mend the matter, the architect employs pilasters and columns 3 ft. 6 in. in diameter, and of a proportionate projection, which, with the space required for their bases, must reduce the ground some 2 feet and more in width; and, except the space allowed near the entrance for a most inconvenient winding-stair on one side, and a similar space, but how occupied I know not, on the other, must contract it about 5 feet in length. Again, the building is required to be very lofty in proportion to its extent, and we find an order without an attic employed, although the longest side of the edifice presents nearly a square in elevation, and the shorter about a square and two-thirds in height. Further, the ground is irregular in form; and a pediment being placed over the narrow side, the obtuse angle on the one side, and the acute on the other, become most painfully obvious; while the wall within the columns, being kept at right angles to the long side, and therefore not parallel to its own line of front, quickly calls attention to the irregularity of the plan. The site is about 56 feet by 33, and the interpilastered spaces are two diameters or seven feet; the order, which nearly follows the proportion of the Jupiter Stator example, is raised on a plinth about four feet in height, which latter is pierced for the basement windows; there are three tiers of openings in the height of the order, and the whole exhibits the proportions indicated by the annexed sketches.

Fig. 1.—Front Elevation.

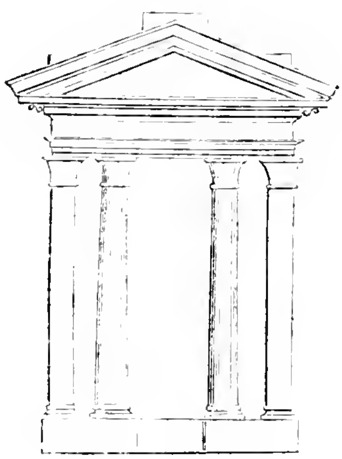
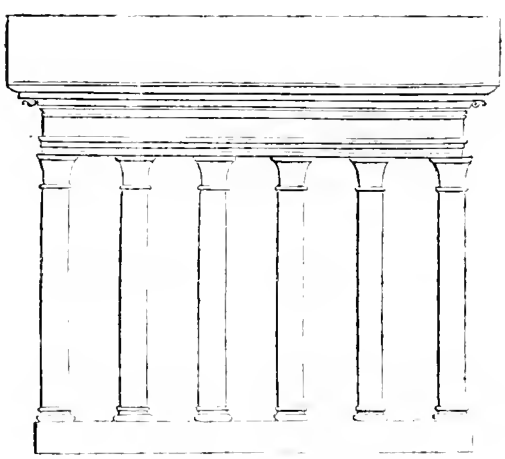


Fig. 2.—Side Elevation.



The effect in perspective may be conceived, and I ask whether excellence of detail could atone for such an outrage on architectural propriety and taste as a temple-form structure like this, with three stories in an order. This is an example of the effects of modern competition: where the successful architect, having had his design adopted in consequence, it is said, of his private interest in the committee of management, has not only the advantage, as was understood at the time, of examining those of his competitors, during the six weeks which elapsed between the decision of the committee and the return of the designs to their respective authors, but is permitted to expend about twice the amount to which they were, in the first instance, limited, and this for the purpose of producing a building which is a perfect burlesque on all correct proportion. The execution is creditable to the contractor, but in consequence of having a very poor plaster cast to work from, the capitals are not at all like those of the example professed to be followed. The Union Bank follows its Welsh neighbour in Eder's list. I readily admit the beauty of the Ionic columns, in which a leafy termination has been adopted for the flutes, somewhat in the manner of those in the columns of the monument of Lysicrates. The capitals of the antæ are also original and tasteful, and the bases of both, in which an inverted ovolo is used in place of the upper torus, are improvements on the common attic one; a similar base has been used by Mr. Foulston in the Plymouth theatre. Beyond these details I can discover nothing in this design at all commendable, nor bearing the least trace of the taste which seems to have dictated them. The pediment is filled entirely by the convolutions of an immense motto riband which Eder calls "bold;" would not impudent be a more applicable term? The honeysuckle in the frieze is stiff and ungraceful in the extreme, as are the carvings of foliage and tendrils which occupy part of the panel within the columns. Let any one spend an hour in looking over Stuart's Athens, or Inwood's Erechtheum, and then, walking to this bank, say how much of Grecian character any of these details exhibit. The ponderous truss which stops the cornice at the end next the adjoining building, has a most cast-iron air, as have also the windows of both floors, and the square sham balustrade above them. The lower windows have pediments above a frieze, which is separated from the architrave only by projecting about ¼ of an inch beyond it; while the architrave itself has its moulding sunk on its inner margin, which may occasionally have a good effect in buildings of rustic or unornate character, but seems much at variance with the degree of enrichment which is affected in other parts of this building. The dressings of the small square windows above these I consider equally objectionable, for in them the *fillet* of the architrave alone is broken into knees on every side, while the moulding itself follows the line of the opening. This has a very paltry, poor effect. The pedestals which divide the balustrades into lengths are panelled, and the panels filled with flowers which bear a closer resemblance to tin tartlet moulds with a knob in the middle, than anything else I can think of. The carvings under the portico represent, I suppose, the ladies of the three kingdoms just after the round tea-table has been removed; with a background exhibiting a steam-carriage in full cry along a viaduct which appears to have no end, like the Irishman's rope, beneath which ships are to be seen afloat in something like scale armour. This piece of sculpture forms part of an amusing history. The panel of which it now occupies the centre, was originally filled with foliage and scroll work of similar character to that which now occupies its ends; and the "illustration" of the principle of union was intrusted to two feathered bipeds, who surmounted the pediment, and lugged, each with one foot, at the ends of a cord which encircled what was meant for a bundle of sticks, but bore more resemblance to part of a reeded column. These notable fowls were said to be of the liver or cormorant species; but were much more like, in their proportions and plumage, to the ancient effigy of the supposed fabulous dodo. Short was their reign in their exalted station: the Bank directors not, I suppose, feeling flattered by the constant grins and broad jests of the group of idle corn porters whom the novelty attracted to the opposite corner, and the less obstreperous mirth of the more polished passengers, deposed these eminent sea-birds, and substituted an acroterial honeysuckle closely conforming to the metallic rigidity of character exhibited by its brethren in the frieze, the foliage in the centre of the panel was cut away, the ladies above-mentioned soon made their debût, and no doubt will enjoy a more permanent occupation than their less fortunate predecessors. In closing my remarks on this building, I must observe that, though the stone of which it is built is excellent, and the execution likewise particularly good, the general effect is far from agreeable, there being an angularity and hardness in the details, and a general harshness of outline, which convey an impression of repulsive coldness, and cause an entire want of that attractive lively air which many buildings possess, without at all detracting from that substantiality of expression which should characterize a place of business, and most of all, a Bank. In closing my subject for the present, I can assure Eder, that as regards the Branch Bank of England, I had rather have the credit of designing its street front than the whole of the three joint stock banks he has noticed.

I should have observed, with regard to the Union Bank, that it lays claim to being a complete example of Greek character. I have no hesitation in saying, that beyond the columns and antæ there is not the least ground for such pretensions; but on the contrary, that in common with other buildings affecting Grecian details in this town—with the exception of the pretty little model of the temple of Jupiter Panhellenius, which stands above what was once a most picturesque stone quarry, but has since been spoiled into St. James's Cemetery—it is a glaring example of the inapplicability of that style to ordinary modern uses, showing how completely its unity and simplicity of character are destroyed when more than one height of openings is required, and how impossible it is, by pretending to preserve the details in mouldings, and (save the mark!) in ornament, to overcome the difference of expression which this and other equally wide departures from ancient practice produce in the whole. Moreover, the frequent fractures which mar the entablatures of our Anglo-Grecian buildings should teach us how unfit the common building-stones of this country are for the long bearings and great superincumbent weights which the use of this style imposes on us, but for which the Greek marbles were so eminently adapted. The assumption which some have endeavoured to maintain, that the architects of Greece confined themselves to horizontal composition on account of the superior grandeur of effect which could be so produced, is sufficiently refuted by our own magnificent cathedrals; and I am myself convinced that, had the principle of the arch been known to them, and the almost illimitable power which the architect, by its means, obtains over his materials, none would more fully have availed themselves of its aid than these great masters in science and art. I am aware that I am liable to the charge of reviving truisms; but there are architects who seek to conceal their own dullness under an affectation of enthusiastic admiration of the style of ancient Greece; who abandon and pretend to despise the use of the arch in their designs, because it was unknown to, and consequently unused by, the Greeks, and thus produce buildings which can never be otherwise than unsubstantial and insecure, because constructed of materials unfit for the practice of the style which they affect to follow. I remarked in speaking of the Custom House, that fractures were visible in the stone-work, which I could only attribute to a settlement in the foundations. I have since been confirmed in this opinion, by observing seven or eight similar fractures, particularly in the south and south-western parts of the building, some of a most serious and threatening aspect; thus this extensive and costly pile will, probably ere long, require, like its prototype in London, a repair almost as expensive as its first erection. But to return to the banks. Having disposed of the principal joint stock banking-houses, Eder attacks, without mercy, the building in which the branch business of the Bank of England is conducted. Of the interior of this bank I know but little, and any apparent want of convenience may be perhaps sufficiently accounted for by the fact of its having been originally a private dwelling-house. With respect to the exterior, however, I can assure you and your readers, Mr. Editor, that it is one of the most pleasing street fronts which the town contains. It is of Italian character, exhibiting a Corinthian pilastral order of five intercolumns on a solid basement, with two stories in the height of the order, and an attic above it. The wall between the pilasters and the attic piers, as well as that of the basement is rusticated throughout. The ground floor windows have no other decoration than their moulded cills, and the centre opening, which till very lately was occupied by the door, has the only pediment in the façade, supported on bold trusses. The cills of the one pair windows are lighter and more decorative in character than those of the ground floor, beside being supported by trusses of varied detail and pleasing design, from which festoons of fruit and flowers descend towards the heads of the ground floor openings. The attic is perhaps too high for the order it surmounts, but not more so than is the case in many well known buildings; Greenwich Hospital for example; and the narrowness of the street, and the projection of the cornice almost neutralize this defect. The festoons are well designed and executed, and harmonize with the decorative character of the Corinthian order employed, as does also, in my opinion, the rusticated surface of the intermediate masonry. I do not know the date of this house, nor the name of its designer, but should think it must date some 80 years back; at all events it does credit to his taste, and I am certain that most persons making any pretensions to architectural taste would agree with me that it is much to be preferred before any of the modern banks which have been noticed by Eder. The removal of the door from its proper place in the centre, to the meagre Roman Doric porch beyond the line of front, has injured the unity of the composition, and the subsequent scraping of the stonework has given it all the rawness of a newly finished building, without its sharpness of detail. In closing my remarks on this bank I cannot but express my astonishment at, and pity for, the *taste* which could find so much to admire in the tortured and unnatural decorations of the Union Bank, in the misproportion and coarseness of the Welsh, and consign the Branch Bank to such unqualified reprobation.

The markets next engage the attention of your correspondent. He commends the fish market as well adapted to its purpose, which may be the case now, but certainly was not until the fish-fags rose en masse, and with sundry threats of violence to the architect, demanded and obtained the admission of light in the side walls. St. John's market is capable of fine effects of light certainly, in consequence of its great extent, which on plan is about the same as York Minster, but other merit I cannot discover in it, and the construction of the roof is of the most ordinary and journeyman-like description. In referring to St. James's cemetery I was reminded of the circular structure in which Gibson's beautiful statue of Huskisson is immolated. Independently of the absurdity of setting an eight foot statue in a place not twice that height in diameter, the thing is in itself most ungraceful. I am perhaps forestalling Eder, but he must excuse me. Adopting the details of the Tivoli example of the Corinthian order, the architect appears to have aimed at a mean between the proportions of the temple to which it belongs, and the well known monument of Lysicrates. The result is, that the proportions are neither those of horizontal composition like the temple of Tivoli, nor of vertical, like those of the little monument named. Perhaps habit has given these two ancient examples almost the authority of rule as to the proportions of circular buildings in the classic styles. At all events the medium here attempted is a complete failure, and Bramante's little temple of St. Peter in Montorio, might have given the architect a hint that a varied outline might be preferable to a severe one in so small a building. The terminal which crowns the cupola is far from redeeming the other defects of the design. The enormity of burying so fine a work of art as Gibson's statue in a coop like this, is the more to be regretted, as another by the same eminent sculptor which was intended to occupy the centre of the long room in the Custom-house, has, with the vessel which contained it, gone to the bottom of the sea, somewhere near the mouth of the Tiber. The cemetery in which this (I really scarce know what to call it, for it is neither a mausoleum nor a monument), statue-box stands as one of the lions of Liverpool, and as a matter of course *must* be admired by every body, but really those who do so must prefer seeing animals in a reclaimed rather than a natural state, for it is a very tame lion. I could say more on this subject, but shall refrain for the present; for should Eder, like other "strangers," launch out in admiration thereof, I should prefer giving my opinion in the form of a reply to his.

I am, Sir,
Yours, &c.,
H.

Liverpool,
Jan 22nd, 1841.

ON THE STYLE OF CAMPBELL AS COMPARED WITH THAT OF INIGO JONES.

In pursuing a criticism upon the genius of the Palladian school, the excuse rests chiefly on the influence its pupils have had upon the growth of classic beauty, and on the exertions they have made to rescue the treasures of antiquity from the dust: and though, in looking amidst the ranks of Palladio's followers, we see art for a second time as it were cradled, void alike of vigour or of finish, we cannot but feel pleasure in peeping at its once infant condition, especially as we contrast it with its more advanced state: nor can we feel otherwise than sanguine, as we catch through this in fair perspective its promise of hastening maturity.

Up to the 16th century architecture was less definite in outline, less studied in symmetry;—you were awed by the mass, or were charmed by the intricacy of its parts;—you were arrested, it is true, but then the whole was after all only an agreeable perplexity. It was reserved for Jones and his followers to turn the stream of taste and to transplant the graces of Italy. But the followers of Jones had not very much of their master's sentiment. They seem to have followed the fashion of the time, as much as the sentiment of Palladio. Hence we find Hawkesmore and Vanburgh easily catching the precise feeling of Grecian rule, to the prejudice of the Italian.

Campbell however as a follower of Jones, and as a Palladian architect, seems more deserving of attention, though whether he features the original, or only staggers after him is a question.—In his mansions, (so many of which grace our land) the sentiment of Palladio and the style of Jones seem both affected. Still you are conscious at the first glance of a stiffness in the design. You feel if an importent part is to arrest that it becomes very often unpleasantly independent of the remainder; or if a change of features are successively to please, that you are not led to them by approaches sufficiently easy. The eye is not courted, it is forced.—Sudden changes too often occur from the horizontal to the vertical, in that part where altitude is the aim; and very often in the front a sudden depression of the sides, disuniting to a certain extent the centre from the rest, and destroying in a measure the harmony of relations by a want of unity. It seems as if the artist occasionally lept into his parts; as if notwithstanding his apparent study of every subordinate feature in the Pallatial style, and of the principles of Italian arrangement, the stiffness of the copy must remain, rather than the freedom of the original. It is true that you are looking at the design of a Palladian architect; that there are dispositions of the void and enriched, of the depressed and the elevated; that there are the same segmental and triangular windows in mutual relief; that balustrades crown the void, and that turrets, cupolas, columns, figures, &c. prevent you dwelling on the breadth: but then you see too much of a studied arrangement. You can almost detect the labours of the artist; you can almost discern the process by which the features of his design are apportioned; you see the architect as much as his edifice. When he introduces ornament he makes you to revel very often in a part where the eye should not remain, or he encloses a free figure in some stiff panel and destroys its expression. The decoration is not such that the part would look bare without it, or that the proportion would become affected if it was not there. You see not as in Jones the ornament as identified *with* the mass, but only as a part of it. You detect too much of the hand which placed it there, and too little of its relation to surrounding objects.

Contrasting him with Jones whom he imitates, or with Palladio whom he affects, we at once see that his very study makes him miss the careless beauties of the former, whilst his caution prevents him soaring into the grand simplicity and rich excellence of the latter.

Campbell thus although of the Palladian school is only of such in its leading characteristics. That quick perception of grace and of beauty ever necessary to relieve the huge superficies is not his. His sensibilities seem dull upon the lesser auxiliaries, so useful to design. He is not grand in his comprehension, and yet at the same time minute in his care; or if he does descend to minuteness, he does not change from the greater to the less, from the grand to the inferior with the care of a genius, but creeps into his parts with the fear of a copyist. Finally, he seems to have wanted more quickness of apprehension, more fertility of thought, and more liveliness of fancy, to have in any way equalled his originals.

FREDERICK EAST.

February 10, 1841.

ST. LUKE'S CHURCH, CHEETHAM HILL.

SIR—Being a constant reader of your most valuable Journal, and knowing the great number of communications which must be forwarded to you for perusal, I appreciate the difficulty of the task you have to perform in selecting those which may best serve the two professions, the interests of which you so strenuously and successfully advocate. By way of apology for this communication, the following reasons may be deemed sufficient.

1st. I consider the design and execution of the edifice alluded to to be of such high excellence, that it is only doing a bare act of justice to the architect to whose genius we are indebted for this beautiful work of art, and also to the admirers of modern ecclesiastical architecture, to give a greater publicity to it than it has yet received, and

2ndly. Not having observed anything more than a casual notice of this edifice in your publication, I think a few descriptive remarks, even from an incompetent person, if given in sincerity, and with an eye to the advantage and improvement of the profession, would not be misapplied.

The church under consideration is advantageously situated in the township of Cheetham, on the main road from Manchester to Bury. The funds were raised by subscription, some of the principal residents in the neighbourhood being most liberal in their donations; it is erected from the design of J. W. Atkinson, Esq., architect, who has adopted the Gothic style most happily blending the late ornamental with the early perpendicular style. It is very simple in plan, the body of the church being divided by two rows of piers and arches into nave and aisles; there is a steeple at the west end, and an altar recess at the east, behind which is a large vestry. There are galleries in the aisles and at the west end. The roof of the nave is carried much higher than that of the aisles, so as to admit of clerestory windows.

The steeple consists of a tower and spire. The former has octagon turrets with buttresses at the angles, terminated with crocketted pinnacles. The lower compartment has a well proportioned and deeply recessed doorway, over which is a lofty perpendicular window, and at the sides are windows similar in style. The spandrils over the large window are filled with perpendicular tracery, in the centre of which is the clock. The belfry has two narrow windows on each side, and is crowned with a bold cornice and perforated battlement. The spire is crocketted at the angles, and beautifully connected with the tower by perforated flying buttresses springing from the pinnacles at the angles of the tower; it is finished with a belt and crocketted finial, surmounted by a cross, the emblem of Christianity.

The aisles are divided by buttresses and crocketted pinnacles into six compartments, each decorated with a lofty window: the clerestory has two windows to every one in the aisles, also divided by smaller buttresses and crocketted pinnacles. The nave terminates at the east end with octagon buttresses, and a lofty *side* window to light the altar recess. The east end is simple but original, having *no large east window*, but three well proportioned niches in its place. The ends of the aisles are finished with windows similar to those in the side, and buttresses at the angles.

The whole of the external detail, window dressings, cornices, &c., are good, plain, and effective, and it seems to have been the aim of the architect to obtain a good outline rather than any small frittered ornament, which is only gained at a great expense and trouble, to be lost sight of when viewed at a little distance.

On entering the churchyard from Manchester, the spectator has a S.W. view of the church, the tower standing boldly forward, and the pinnacles and flying buttresses which connect it with the spire giving a diversity of shadow which is most beautiful. The beauty of this view is somewhat lessened by the three large windows in the tower, which crowd it too much, and having only the octagon buttresses at each angle, they seem inadequate to support the weight of the belfry and spire; it is also a pity that the spire was not higher, as it does not harmonize with the beautiful proportion of the tower. At the east end you see the effect of the three niches, which are substituted for the great window.

From the tower you enter a vestibule under the gallery, which is divided from the body of the church by an ornamental glass screen. In the centre of the vestibule and opposite to the entrance door, is a handsome stone font, and on the right and left are doors which communicate with the gallery stairs as well as the body of the church. The altar is beautifully ornamented with perpendicular panels and niches, with richly ornamented canopies; it is lighted by side windows, which have a good effect. It is composed of two compartments, divided by a bold cornice, which runs underneath the side windows. The lower one consists of three Gothic panels with heads of tracery, in which are written the Creed, Commandments, and the Lord's Prayer; on one side of the altar table is a deeply recessed doorway to vestry, and on the other a false one to correspond. The side walls under windows are beautifully ornamented by a series of small arches, springing from isolated columns with foliated caps and bases, forming a sort of triforium. The top compartment consists of a large centre panel, which it is hoped will be fitted with some talented painting; on each side of this are niches and rich canopies; the plainness of the wall above this is hid by perpendicular panelling which reaches to the ceiling.

The pulpit, which is situated rather on one side of the altar, is quite exquisite. The base represents a rock, on which are seated statues of our Saviour and two Magdalens which support the pulpit, it being the medium through which the Gospel is propagated. On the other side of the altar is the reading desk, which is a large Gothic chair, with a stand for the books supported by an eagle; between it and the pulpit is a smaller chair for the clerk.

The organ screen is very beautiful, in the ornamental style, divided into three compartments by niches, canopies, &c., and crowned by three crocketted spires and pinnacles. The organ is a very good one, built by Hill of London, at an expense of about £600.

On entering the church from the west end, the eye is disagreeably affected by the west gallery projecting too far into the church, and cutting short the view of the altar piece; this, however, ceases when you get fairly into the church, and if viewed on a fine day, is very chaste and elegant. Turning round on reaching the altar, you have a view of the organ screen. It is to be regretted that it and the altar piece do not accord better as to style, for there is decidedly a want of unity in them when viewed as part of the same edifice.

I am happy in being able to state that the finishing and painting of this beautiful church was intrusted to the care of Mr. Atkinson, who seems to have spared no pains or trouble in fulfilling the arduous task imposed on him. The whole of the walls are tinted of a warm stone colour, the mouldings left white, and the most prominent members of them gilt, which gives it a most rich and mellow appearance. The ceiling over the nave is divided by the roof principals, and moulded ribs into square compartments, and these again painted in imitation of oak tracery and panels. The pews are painted to imitate grained oak, and lined with crimson moreen. There is accommodation for about fifteen hundred people.

The cost of the church I have not been able to ascertain. The design first determined on was to have been erected for about five thousand pounds, but when it was as forward as the window cills, it was altogether altered, and continued to be so until finished, so that it is now supposed to have cost from fourteen to fifteen thousand pounds.

Craving your indulgence for so lengthened and perhaps unprofessional a description of this interesting and beautiful church, and hoping that you may have an opportunity of testing the truth of my remarks by a personal view of it.

I remain, your obedient servant,

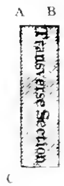
FRANK T. BELLHOUSE, *Architect.*

Grosvenor-square, Manchester,
February 9, 1841.

TABLES ON THE STRENGTH OF BEAMS.

THE formulæ in this Tables are designed to facilitate the computation of the strength and dimensions of Girders, Bressummers, Joists, and other horizontal supports. They are founded on the delicate and important experiments of the late Mr. Thomas Tredgold, combined with the laws of resistance as promulgated by Galileo, and afterwards corrected by Mariotte and Girard. The coefficients are adapted to cast iron of the specific gravity 7·372,* giving a weight of 460¾ lb. to the cubic foot, and they can easily be modified for other materials by simply reducing the tabular constants in the ratio of the specific cohesions, a table of which is subjoined.——NOTE: The results obtained by calculation are all within the limits of elasticity.

l = the length of the beam in feet. m and n = the length of the segments of a beam loaded at some other point than the middle. $m+n=l$ the total length of the beam.

	Rectangular Beams.—Fig. 1.	w = the load in cwts.	b = AB the breadth in inches.	d = AC the depth in inches.	b = A B the breadth, and d = A C the depth in inches.
1	Fixed at one end and loaded at the other . . .	$lw = 1{\cdot}9\,bd^2$	$b = \frac{lw}{1{\cdot}9\,d^2}$	$d = \left(\frac{lw}{1{\cdot}9\,b}\right)^{\frac{1}{2}}$	
2	Fixed at one end and loaded uniformly over the length .	$lw = 3{\cdot}8\,bd^2$	$b = \frac{lw}{3{\cdot}8\,d^2}$	$d = \left(\frac{lw}{3{\cdot}8\,b}\right)^{\frac{1}{2}}$	
3	Supported at both ends and loaded at the middle . .	$lw = 7{\cdot}6\,bd^2$	$b = \frac{lw}{7{\cdot}6\,d^2}$	$d = \left(\frac{lw}{7{\cdot}6\,b}\right)^{\frac{1}{2}}$	Fig. 1. 
4	Supported at both ends and loaded uniformly over the length .	$lw = 15{\cdot}2\,bd^2$	$b = \frac{lw}{15{\cdot}2\,d^2}$	$d = \left(\frac{lw}{15{\cdot}2\,b}\right)^{\frac{1}{2}}$	
5	Fixed at both ends and loaded at the middle . . .	$lw = 11{\cdot}1\,bd^2$	$b = \frac{lw}{11{\cdot}1\,d^2}$	$d = \left(\frac{lw}{11{\cdot}1\,b}\right)^{\frac{1}{2}}$	
6	Fixed at both ends and loaded uniformly over the length .	$lw = 22{\cdot}8\,bd^2$	$b = \frac{lw}{22{\cdot}8\,d^2}$	$d = \left(\frac{lw}{22{\cdot}8\,b}\right)^{\frac{1}{2}}$	
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\,(m+n)\,bd^2$	$b = \frac{mnw}{1{\cdot}9\,(m+n)\,d^2}$	$d = \left(\frac{mnw}{1{\cdot}9\,(m+n)\,b}\right)^{\frac{1}{2}}$	
8	Fixed at both ends and loaded at some intermediate point .	$mnw = 2{\cdot}85\,(m+n)\,bd^2$	$b = \frac{2{\cdot}85\,(m+n)\,d^2}{mnw}$	$d = \left(\frac{mnw}{2{\cdot}85\,(m+n)\,b}\right)^{\frac{1}{2}}$	

	Open Beams.—Fig. 2.	w = the load in cwts.	b = AB the breadth in inches.	d = AE the depth in inches.	b = A B the breadth, d = A E the depth, and $p = \frac{CD}{AE}$
1	Fixed at one end and loaded at the other . . .	$lw = 1{\cdot}9\,bd^2\,(1-p^3)$	$b = \frac{lw}{1{\cdot}9\,d^2\,(1-p^3)}$	$d = \left(\frac{lw}{1{\cdot}9\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
2	Fixed at one end and loaded uniformly over the length .	$lw = 3{\cdot}8\,bd^2\,(1-p^3)$	$b = \frac{lw}{3{\cdot}8\,d^2\,(1-p^3)}$	$d = \left(\frac{lw}{3{\cdot}8\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	Fig. 2.
3	Supported at both ends and loaded at the middle . .	$lw = 7{\cdot}6\,bd^2\,(1-p^3)$	$b = \frac{lw}{7{\cdot}6\,d^2\,(1-p^3)}$	$d = \left(\frac{lw}{7{\cdot}6\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	Transverse Section.
4	Supported at both ends and loaded uniformly over the length .	$lw = 15{\cdot}2\,bd^2\,(1-p^3)$	$b = \frac{lw}{15{\cdot}2\,d^2\,(1-p^3)}$	$d = \left(\frac{lw}{15{\cdot}2\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
5	Fixed at both ends and loaded at the middle . . .	$lw = 11{\cdot}4\,bd^2\,(1-p^3)$	$b = \frac{lw}{11{\cdot}4\,d^2\,(1-p^3)}$	$d = \left(\frac{lw}{11{\cdot}4\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
5	Fixed at both ends and loaded uniformly over the length .	$lw = 22{\cdot}8\,bd^2\,(1-p^3)$	$b = \frac{lw}{22{\cdot}8\,d^2\,(1-p^3)}$	$d = \left(\frac{lw}{22{\cdot}8\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\,bd^2\,(m+n)\,(1-p^3)$	$b = \frac{mnw}{1{\cdot}9\,d^2\,(m+n)\,(1-p^3)}$	$d = \left(\frac{mnw}{1{\cdot}9\,b\,(m+n)\,(1-p^3)}\right)^{\frac{1}{2}}$	
8	Fixed at both ends and loaded at some intermediate point .	$mnw = 2{\cdot}85\,bd^2\,(m+n)\,(1-p^3)$	$b = \frac{mnw}{2{\cdot}85\,d^2\,(m+n)\,(1-p^3)}$	$d = \left(\frac{mnw}{2{\cdot}85\,b\,(m+n)\,(1-p^3)}\right)^{\frac{1}{2}}$	

* If the specimen under consideration be of different specific gravity from this, the calculated strength must be reduced in the same proportion.

† Divide by the length for the load in cwts., or divide by the weight in cwts. for the length in feet.

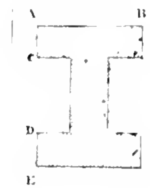
TABLES ON THE STRENGTH OF BEAMS.

	Grooved or Double Flanged Beams.—Fig. 3.	w = the load in cwts.	b = AB the breadth in inches.	d = AE the depth in inches.
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}9\ bd^2\ (1 - qp^3)$	$b = \frac{lw}{1{\cdot}9\ d^2\ (1 - qp^3)}$	$d = \left(\frac{lw}{1{\cdot}9\ b\ (1 - qp^3)}\right)^{\frac{1}{2}}$
2	Fixed at one end and loaded uniformly over the length	$lw = 3{\cdot}8\ bd^2\ (1 - qp^3)$	$b = \frac{lw}{3{\cdot}8\ d^2\ (1 - qp^3)}$	$d = \left(\frac{lw}{3{\cdot}8\ b\ (1 - qp^3)}\right)^{\frac{1}{2}}$
3	Supported at both ends and loaded at the middle	$lw = 7{\cdot}6\ bd^2\ (1 - qp^3)$	$b = \frac{lw}{7{\cdot}6\ d^2\ (1 - qp^3)}$	$d = \left(\frac{lw}{7{\cdot}6\ b\ (1 - qp^3)}\right)^{\frac{1}{2}}$
4	Supported at both ends and loaded uniformly over the length	$lw = 15.2\ bd^2\ (1 - qp^3)$	$b = \frac{lw}{15.2\ d^2\ (1 - qp^3)}$	$d = \left(\frac{lw}{15{\cdot}2\ b\ (1 - qp^3)}\right)^{\frac{1}{2}}$
5	Fixed at both ends and loaded at the middle	$lw = 11{\cdot}4\ bd^2\ (1 - qp^3)$	$b = \frac{lw}{11{\cdot}4\ d^2\ (1 - qp^3)}$	$d = \left(\frac{lw}{11{\cdot}4\ b\ (1 - qp^3)}\right)^{\frac{1}{2}}$
6	Fixed at both ends and loaded uniformly over the length	$lw = 22{\cdot}8\ bd^2\ (1 - qp^3)$	$b = \frac{lw}{22{\cdot}8\ d^2\ (1 - qp^3)}$	$d = \left(\frac{lw}{22{\cdot}8\ b\ (1 - bp^3)}\right)^{\frac{1}{2}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\ bd^2\ (m+n)\ (1 - qp^3)$	$b = \frac{mnw}{1{\cdot}9\ d^2\ (m+n)\ (1 - qp^3)}$	$d = \left(\frac{mnw}{1{\cdot}9\ b\ (m+n)\ (1 - qp^3)}\right)^{\frac{1}{2}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = 2{\cdot}85\ bd^2\ (m+n)\ (1 - qp^3)$	$b = \frac{mnw}{2{\cdot}85\ d^2\ (m+n)\ (1 - qp^3)}$	$d = \left(\frac{mnw}{2{\cdot}85\ b\ (m+n)\ (1 - qp^3)}\right)^{\frac{1}{2}}$

b = AB the breadth, d = AE the depth, $p = \frac{CD}{AE'}$ and $q = \frac{2 \cdot CF}{AB}$

Fig. 3.

Transverse Section.



	Feathered or Single Flanged Beams.—Fig. 4.	w = the load in cwts.	b = AB the breadth in inches.	d = AG the depth in inches.
1	Fixed at one end and loaded at the other	$lw = \frac{7{\cdot}6bd^2\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{7{\cdot}6\ d^2\ (1-qp^3)\ (1-q)}$	$d = \left(\frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-b})^2}{7{\cdot}6\ b\ (1-qp^3)\ (1-q)}\right)^{\frac{1}{2}}$
2	Fixed at one end and loaded uniformly over the length	$lw = \frac{15{\cdot}2\ bd^2\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\ (\sqrt{1-qp^3} + \sqrt{-q})^2}{15{\cdot}2\ d^2\ (1-qp^3)\ (1-q)}$	$d = \left(\frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{15{\cdot}2\ b\ (1-qp^3)\ (1-q)}\right)^{\frac{1}{2}}$
3	Supported at both ends and loaded at the middle	$lw = \frac{30{\cdot}4\ bd^2\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{30{\cdot}4\ d^2\ (1-qb^3)\ (1-q)}$	$d = \left(\frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{30{\cdot}4\ b\ (1-qp^3)\ (1-q)}\right)^{\frac{1}{2}}$
4	Supported at both ends and loaded uniformly over the length	$lw = \frac{60{\cdot}8\ bd^2\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{60{\cdot}8\ d^2\ (1-qp^3)\ (1-q)}$	$d = \left(\frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{60{\cdot}8\ b\ (1-qp^3)\ (1-q)}\right)^{\frac{1}{2}}$
5	Fixed at both ends and loaded at the middle	$lw = \frac{45{\cdot}6\ bd^2\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{45{\cdot}6\ d^2\ (1-qp^3)\ (1-q)}$	$d = \left(\frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{45{\cdot}6\ b\ (1-qp^3)\ (1-q)}\right)^{\frac{1}{2}}$
6	Fixed at both ends and loaded uniformly over the length	$lw = \frac{91{\cdot}2\ bd^2\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{91{\cdot}2\ d^2\ (1-qp^3)\ (1-q)}$	$d = \left(\frac{lw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{91{\cdot}2\ b\ (1-qp^3)\ (1-q)}\right)^{\frac{1}{2}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = \frac{7{\cdot}6bd^2\ (m+n)\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{mnw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{7{\cdot}6\ d^2 (m+n)(1-qp^3)(1-q)}$	$d = \left(\frac{mnw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{7{\cdot}6\ b (m+n)(1-qp^3)(1-q)}\right)^{\frac{1}{2}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = \frac{11{\cdot}4\ bd^2\ (m+n)\ (1-qp^3)\ (1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{mnw\ (\sqrt{1-qp^3} + \sqrt{1-q})^2}{11{\cdot}4\ d^2 (m+n)(1-qp^2)(1-b)}$	$d = \left(\frac{mnw(\sqrt{1-qp^3} + \sqrt{1-q})^2}{11{\cdot}4\ b (m+n)(1-qp^3)(1-q)}\right)^{\frac{1}{2}}$

b = AB the breadth, d = BD or AG the depth, $p = \frac{DC}{BD}$ and $q = \frac{DE + FG}{AB}$

Fig. 4.

Transverse Section.

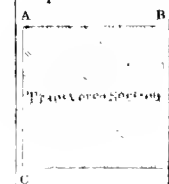
TABLES ON THE STRENGTH OF BEAMS.

	Square Beams.—Fig. 5.	w = the load in cwts.	s = AC the side in inches.
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}9\,s^3$	$s = \left(\frac{lw}{1{\cdot}9}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length	$lw = 3{\cdot}8\,s^3$	$s = \left(\frac{lw}{3{\cdot}8}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle	$lw = 7{\cdot}6\,s^3$	$s = \left(\frac{lw}{7{\cdot}6}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length	$lw = 15{\cdot}2\,s^3$	$s = \left(\frac{lw}{15{\cdot}2}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle	$lw = 11{\cdot}4\,s^3$	$s = \left(\frac{lw}{11{\cdot}4}\right)^{\frac{1}{3}}$
6	Fixed at both ends and loaded uniformly over the length	$lw = 22{\cdot}8\,s^3$	$s = \left(\frac{lw}{22{\cdot}8}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\,(m+n)\,s^3$	$s = \left(\frac{mnw}{1{\cdot}9\,(m+n)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = 2{\cdot}85\,(m+n)\,s^3$	$s = \left(\frac{mnw}{2{\cdot}85\,(m+n)}\right)^{\frac{1}{3}}$

s = A C the side of the section in inches.

Fig. 5.

Square section.

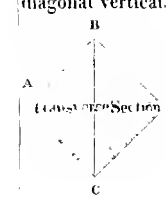


	Square Beams, the diagonal vertical.—Fig. 6.	w = the load in cwts.	s = AB the side in inches.
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}31\,s^3$	$s = \left(\frac{lw}{1{\cdot}31}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length	$lw = 2{\cdot}68\,s^3$	$s = \left(\frac{lw}{2{\cdot}68}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle	$lw = 5{\cdot}36\,s^3$	$s = \left(\frac{lw}{5{\cdot}36}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length	$lw = 10{\cdot}72\,s^3$	$s = \left(\frac{lw}{10{\cdot}72}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle	$lw = 8{\cdot}01\,s^3$	$s = \left(\frac{lw}{8{\cdot}01}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded uniformly over the length	$lw = 16{\cdot}08\,s^3$	$s = \left(\frac{lw}{16{\cdot}08}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}31\,(m+n)\,s^3$	$s = \left(\frac{mnw}{1{\cdot}31\,(m+n)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = 2{\cdot}01\,(m+n)\,s^3$	$s = \left(\frac{mnw}{2{\cdot}01\,(m+n)}\right)^{\frac{1}{3}}$

s = A B the side of the section in inches.

Fig. 6.

Square section, diagonal vertical.



Specific Cohesion, or Comparative Strength.	
Cast Iron, *Standard*	1·331
Arbutus	1·845
Ash, Red	1·899
White	1·804
Bay	1·547
Beech	1·880
Chestnut	1·291
Elm	1·432
Fir	1·380
American	0·942
Memel	1·154
Red	1·172
Riga	0·964
Russian	1·062
Scotch	0·837
Yellow	0·900
Larch, Scotch	0·837
Mahogany, Spanish	1·283
Maple	1·123

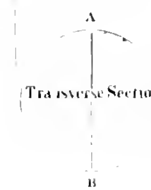
TABLES ON THE STRENGTH OF BEAMS.

	Cylindrical Beams.—Fig. 7.	w = the load in cwts.	d = AB the diameter in inches.
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}112\, d^3$	$d = \left(\frac{lw}{1{\cdot}112}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length	$lw = 2{\cdot}224\, d^3$	$d = \left(\frac{lw}{2{\cdot}224}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle	$lw = 4{\cdot}448\, d^3$	$d = \left(\frac{lw}{4{\cdot}448}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length	$lw = 8{\cdot}896\, d^3$	$d = \left(\frac{lw}{8{\cdot}896}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle	$lw = 6{\cdot}672\, d^3$	$d = \left(\frac{lw}{6{\cdot}672}\right)^{\frac{1}{3}}$
6	Fixed at both ends and loaded uniformly over the length	$lw = 13{\cdot}344\, d^3$	$d = \left(\frac{lw}{13{\cdot}344}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}112\,(m+n)\, d^3$	$d = \left(\frac{mnw}{1{\cdot}112\,(m+n)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = 1{\cdot}668\,(m+n)\, d^3$	$d = \left(\frac{mnw}{1{\cdot}668\,(m+n)}\right)^{\frac{1}{3}}$

d = A B the diameter of the section in inches.

Fig. 7.

Circular Section.

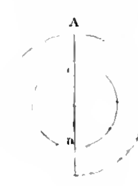


	Tubular Beams.—Fig. 8.	w = the load in cwts.	d = AB the exterior diameter in inches.
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}112\, d^3\,(1-p^4)$	$d = \left(\frac{lw}{1{\cdot}112\,(1-p^4)}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length	$lw = 2{\cdot}224\, d^3\,(1-p^4)$	$d = \left(\frac{lw}{2{\cdot}224\,(1-p^4)}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle	$lw = 4{\cdot}448\, d^3\,(1-p^4)$	$d = \left(\frac{lw}{4{\cdot}448\,(1-p^4)}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length	$lw = 8{\cdot}896\, d^3\,(1-p^4)$	$d = \left(\frac{lw}{8{\cdot}896\,(1-p^4)}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle	$lw = 6{\cdot}672\, d^3\,(1-p^4)$	$d = \left(\frac{lw}{6{\cdot}672\,(1-p^4)}\right)^{\frac{1}{3}}$
6	Fixed at both ends and loaded uniformly over the length	$lw = 13{\cdot}344\, d^3\,(1-p^4)$	$d = \left(\frac{lw}{13{\cdot}344\,(1-p^4)}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}112\, d^3\,(m+n)\,(1-p^4)$	$d = \left(\frac{mnw}{1{\cdot}112\,(m+n)\,(1-p^4)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = 1{\cdot}668\, d^3\,(m+n)\,(1-p^4)$	$d = \left(\frac{mnw}{1{\cdot}668\,(m+n)\,(1-p^4)}\right)^{\frac{1}{3}}$

d = A B the exterior diameter, and $p = \frac{\text{C D}}{\text{A B}}$

Fig. 8.

Transverse Section.



Specific Cohesion, or Comparative Strength.	
Mulberry	1·492
Oak, American	1·009
British	1·509
Baltic	1·211
Dantzic	0·818
French	1·450
Provence	1·155
Orange	1·761
Pitch Pine	1·284
Plum	1·357
Pomegranate	1·221
Poplar	0·705
Quince	0·841
Tamarisk	1·191
Teak, Java	1·509
Malabar	1·395

The following examples will suffice to show the application of the formulæ:—

Example 1. A cast iron beam of which the transverse section is a rectangle (fig. 1), is supported horizontally on two props placed at the distance of 36 feet apart; what load will the beam sustain at its middle point including the effect produced by its own weight, its depth in the direction of gravity being 22 inches, horizontal breadth 3 inches, and specific gravity 7·372, that of water being unity?

The formula by which this example is resolved, is number 3 of the compartment for the strength of rectangular beams, and by substituting the numerical values of b, d and l, we get

$$w = \frac{7{\cdot}6\, b\, d^2}{l} = \frac{7{\cdot}6 \times 3 \times 22^2}{36} = 306{\cdot}533 \text{ cwts.}$$

If the beam were of Memel Fir of which the specific cohesion is 1·154, that of the given material being 4·334; the strength would be found as follows:—

4·334 : 306·533 : : 1·154 : 81·62 cwt. nearly; and in this way the strength may be calculated for any other material of which the specific cohesion is known.

Example 2. Let the length and depth remain as before, what must be the breadth to sustain the calculated load of 306·533 cwts?

In this case the formula is No. 3 of the values of b, and by substitution, we get

$$b = \frac{l w}{7{\cdot}6 d^2} = \frac{36 \times 306{\cdot}533}{7{\cdot}6 \times 22^2} = 3 \text{ inches.}$$

Example 3. Let the length and the breadth remain, what must be the depth to sustain the calculated load of 306·533 cwts?

Here the formula is No. 3 in the values of d, and by substitution we obtain

$$d = \sqrt{\frac{l w}{7{\cdot}6\, b}} = \sqrt{\frac{36 \times 306{\cdot}533}{7{\cdot}6 \times 3}} = 22 \text{ inches.}$$

And exactly in the same manner may the strength, breadth and depth be calculated for any other case, observing always to employ the constant which is adapted to that particular case.

Example 4. A cast iron beam of which the transverse section is an open rectangle (fig. 2), is supported horizontally on two props 36 feet apart; what load will the beam sustain when equally diffused throughout its length, the breadth being 3 inches, the whole depth 22 inches, the depth of the open part seven-tenths of the whole depth, and the specific gravity 7·372?

The formula for resolving this example is No. 4 of the compartment for open beams, where we have

$$w = \frac{15{\cdot}2\, b\, d^2 (1 - p^3)}{l} = \frac{15{\cdot}2 \times 3 \times 22^2 (1 - {\cdot}7^3)}{36} = \frac{15{\cdot}2 \times 3 \times 484 \times {\cdot}657}{36} = 402{\cdot}7848.$$

The breadth and depth to bear the given load, may respectively be found as in the preceding case.

Example 5. A cast iron beam of the grooved or double flanged section (fig. 3), has its extremities fixed into solid walls which are 36 feet apart; what must be its depth to support a load of 928 cwts. at the middle of its length, the whole breadth being 6 inches, the lesser or middle breadth three-eighths of the whole breadth, and the depth of the middle part or that between the flanges three-fourths of the whole depth?

The formula for this example is No. 5 of the value of d, for the grooved or double flanged section, from which we have, $q = 1 - \frac{3}{8} = \frac{5}{8} = {\cdot}625$, and $p = {\cdot}75$, and therefore it is

$$d = \left(\frac{l w}{11{\cdot}4\, b\, (1 - q p^3)}\right)^{\frac{1}{2}} = \left(\frac{36 \times 928}{11{\cdot}4 \times 6\, (1 - {\cdot}625 \times {\cdot}75^3)}\right)^{\frac{1}{2}} = 25\tfrac{3}{4} \text{ in.}$$

and consequently, the depth between the flanges is $25{\cdot}75 \times {\cdot}75 = 19{\cdot}3125$ or $19\frac{5}{16}$ inches.

Example 6. The whole breadth of a feathered or single flanged beam is 8 inches, the lesser breadth 2 inches, the lesser depth $\frac{5}{8}$ of the whole depth, and the length 36 feet; what must be the whole depth so that it may support a load of 1200 cwts. uniformly distributed over the length, supposing both its ends to be fixed as in the last example?

The formula for this case is No. 6 of the values of d, for the single flanged or feathered section (fig. 4), from which we have $q = \frac{8-2}{8} = {\cdot}75$ and $p = \frac{5}{8} = {\cdot}625$; therefore by substitution we get

$$d = \left\{ \frac{l w\, (\sqrt{1 - q p^3} + \sqrt{1 - q})^2}{91{\cdot}26\, (1 - q p^3 \cdot 1 - q)} \right\}^{\frac{1}{2}} =$$

$$\left\{ \frac{36 \times 1200\, (\sqrt{1 - {\cdot}75 \times {\cdot}625^3} + \sqrt{1 - {\cdot}75})^2}{91{\cdot}26\, (1 - {\cdot}75 \times {\cdot}625^3 \cdot 1 - {\cdot}75)} \right\}^{\frac{1}{2}} = 23{\cdot}903 \text{ inches,}$$

nd consequently the lesser depth is $23{\cdot}903 \times {\cdot}625 = 14{\cdot}94$ inches.

From what has been done above, the mode of reducing the cases for the other sections will become manifest, and since our limits will not permit us to enter at large into the subject, the subsequent illustrations must be left for exercise to the reader.

RAILWAY BILL.

The Board of Trade has opened the campaign against the engineering interests, and we fear with better success than ever. Last year they were defeated on the Steam Navigation Bill, and obtained a partial success on the Railway Act, but by the mere passing of this measure, trivial as it was in itself, they have got the point of the wedge in, and are preparing to drive it home. Fortune has worked well for them in the interim, a series of lamentable accidents continued almost uninterruptedly during the recess, and the government borne on the full tide of public alarm and interested exaggeration, sail on to complete their victory. We attribute their success both last year and this, for we fear that it is already certain, to the inefficient manner in which the opposition was conducted, if indeed that could be called opposition which was to a great degree suicidal assistance. It is true the railway press thundered, but the great division among the railway interests prevented any effective combination, while officious individuals, anxious to show their importance by any kind of meddling, had full opportunity of deluding the ministers as to the feelings of the companies, and of being deluded themselves. We ourselves in this might have been in some degree to blame that we were satisfied with leaving the matter in the hands of the directors, and that we did not enforce that there were other interests also concerned, the representation of which could not fairly be trusted to a body having enough to do to defend themselves. It was a parallel case to the steam navigation bill, and had we done rightly we ought at once to have seen the course which it was our duty to have adopted. We felt that in the one case the steam-boat owners would neglect the interests of the marine engineers, and we aroused that branch of the profession to the necessity of uniting and protecting themselves, co-operating with the steam-boat owners in their opposition to the general principles of the bill, and keeping a watchful eye upon whatever was calculated to affect themselves in particular. A similar course of proceeding it now becomes incumbent upon us to urge in the present instance, the railway directors are absolutely insensible to the dangers which menace themselves, so that it is worse than useless to expect that they will afford any protection to those much more menaced—the engineers. We have seen the disposition to interfere with the due exercise of the profession manifested in the steam navigation bill, and we see it still further developed in the report of the railway commissioners to the Board of Trade. In this report the engineers may find what is in store for them.

With regard to the nature and extent of these powers, the proper distinction appears to us to be that the Government should not attempt to interfere in questions of an experimental nature, which are still subjects of discussion, and admit of a fair difference of opinion among practical men; nor should it attempt to regulate matters of detail, so as to take the management of the railways out of the hands of the parties immediately responsible, viz., the Directors and their officers.

On the other hand, the Government should have the power of enforcing, whenever it is found necessary, the observance of all precautions and regulations which are approved by experince, and are obviously conducive to the public safety. For instance, upon such points as the comparative advantages of six and four-wheeled engines, the best construction and mode of laying down rails, the best form and construction of wheels, axles, &c., and other points of a similar nature, upon which the practice of the best conducted railways differs, and the opinion of the most eminent engineers is by no means decided, it would be premature for the Government to interfere until experience has solved the questions which may still be fairly considered as doubtful.

Here we have an admission that although government do not now interfere, they reserve the right of "doing so at a future period, and they claim the power of introducing upon all railways, whatever has been adopted and proved to be conducive to safety by the practice of those which are considered to be the best conducted." Proved! what has been proved in these days of invention and innovation, has the stage coach been proved? has the sailing vessel? has timber been proved to be the best material for ships? What has been proved to be perfect, or impossible to be superseded? and the Board of Trade would come forward and deprive the engineer of the freedom of competition. Would commissioners, advocates of the fifty-six inch gauge, have allowed the broad gauge and all the consequences attendant on it, or would they have been satisfied with what had been adopted and approved upon the best conducted railways? Would turnpike road commissioners have allowed an approved and adopted mode of communication to be superseded? Let us recollect that invention is already at work to supersede the locomotive, that many of these plans, although not yet brought to bear, have shown great ingenuity, and have been made to work: and is competition to be dependent on the dictum of government commissioners? If the engineers think they will work best in government harness, let them be submissive: if they do not think so, let them at once step forward, and act before it is too late. The railway engineer has had his province invaded often enough by Irish and English railway commissioners to know what he has to expect, so that he ought to want but little urging to impel him to do his duty. The locomotive engineer will see that he has advisers ready to dictate to him the number and form of the wheels of his engines, the axles "and other points of a similar nature," whose thraldom, unless he escape by his own exertions, he will find it difficult to avoid. The marine engineers, and the other branches of the profession have their interests concerned in those of the profession generally, and they must recollect that in fighting this battle they are fighting their own. "Lazarus is not dead, he only sleepeth,"—steam navigation jobs, if they have one head cut off, hydra-like always produce more, and the success of the railway measure will furnish a precedent by which other and more stringent enactments may be obtained. We call therefore on the profession generally to meet, and resist the proposed invasion of their rights—to dismiss all personal disputes on this occasion, and to see only their personal interests—let the younger members of the profession not be behind hand, their career is before them, and if they do not wish their prospects to be blighted, and themselves converted into a set of government sycophants, let them support their elder brethren in maintaining the general cause. We have "nostro consilio" successfully aided in one campaign, we have been rewarded by the thanks of the interest, which we defended, and we pledge also on the issue of the present effort, the same exertions and the same regard for the rights of our constituency.

The chief stipulations which we consider that the profession should make with the government are,

First. That as little interference as possible should take place upon subjects connected with engineering, and that such interference should be limited to matters rendered absolutely imperative by public safety.

Second. That no regulation should be made without the subject in question having been duly investigated, either by the Institute of Civil Engineers, or by a commission composed of engineers belonging to the branch to which the subject relates, not railway commissioners, government engineers, or royal engineers.

Third. That examinations directed by the act shall be public, according to a regulated and uniform plan, and shall be conducted by the Institute of Civil Engineers, or by the departments of Engineering of the Universities of London, Glasgow or Durham.

Fourth. That in case of a difference of opinion between the commissioners and engineers, it shall be left to the decision of arbitrators nominated by each party.

Fifth. That a portion of the railway commission shall be composed of civil engineers.

ENGINE DRIVERS ON RAILWAYS.

The late accidents on railways, and the unfortunate loss of life which has occurred in many cases, have naturally directed public attention more forcibly towards providing some efficient remedy against their recurrence; for although it is very true that the accidents frequent by the former method of conveying the public by coaches were, for the most part, attended by a much greater proportionate loss of life than has occurred on railways, we naturally expect that the talent and expenditure employed in completing these undertakings would have obviated such calamities by foresight and arrangement, and in confirmation of the justice of this opinion, it is further remarkable that accidents, till recently, have been very unfrequent and seldom attended by loss of life. Many railways were opened during the past year, and their want of organization may have tended to cause irregularity. We may also be allowed to entertain an opinion that previous success on older railways has caused, in some degree, a relaxation of care on the part of those entrusted with the management of new ones, both in the selection of proper officers, and in carrying out the recommendations of those professionally engaged in the practical detail, so as to effect that uniformity of action throughout the entire establishment which is necessary to insure success. In the management of a railway, as in that of the army, it appears necessary that business should be conducted by a head manager, deriving his authority and receiving instructions immediately from the board of directors, having under him gradations of officers, who should be held responsible for the due performance of the duties of themselves and their subordinates, and have the power of appeal to the board of directors in cases of dispute, they should also be protected from the individual interference of receiving orders from any other than their superior officer in each department respectively, and these superior officers from the manager as the official organ of the directors.

It may be argued by many, that such an arrangement as we propose would open a door to abuse of power by the superior officers and manager, but a determination on the part of the directors to maintain order and gentlemanly feeling among them, by considering with impartiality and minuteness every case of appeal brought under their notice, and by reprimanding the delinquent, however high his station, would effectually curb any such evil.

Most, if not all, railway companies have established some code of regulations for a portion, at least, of their servants but recent inquiries seem to show that they have not always been enforced with the decision necessary to render them available in all cases, and it is doubtful how far they may embrace and define the duties of every servant connected with the executive, for unless their respective responsibilities are clearly understood, it will become difficult to ascertain which of two parties may have acted improperly, although each be actuated by a laudable desire to further the safety of the public and the prosperity of the railway; the decision on the part of the directors becomes doubtful, and perhaps the occasion may pass without being legislated upon at all, or at most an order is passed which, being observed for a time, falls into disuse from its isolated character; and if it becomes necessary to adopt any improved local arrangement, this is also in danger of being applied to individual cases rather than to the general system.

The responsible duties of the engine-driver conducting each railway train, have marked him out as the peculiar object of public inquiry and censure, and it may be naturally assumed as unfortunate that these men have risen in many cases from classes uneducated, so far as book learning is concerned. The knowledge of reading and writing, no doubt, gives man a moral standing and feeling of confidence that can be acquired in no other way, but we by no means admit that engine drivers are uneducated for the duties required of them, after having undergone a practical apprenticeship for many years as assistants on the engines they emulate to conduct and being intrusted with their care after proving themselves sober and attentive servants.

Men educated in the theoretical knowledge of the laws of latent heat and expansion of fluids, would, we think, be quite unable to conduct an engine ten miles without an accident, unless they were practically initiated in its management by serving an apprenticeship to the more menial duties; and it is very doubtful how far he would exercise the continued watchfulness and caution necessary, if the sense of danger were removed by too much confidence in the efficiency of an education such as has been proposed by sending them to institutions for acquiring this knowledge.

Of the many accidents which have lately occurred on railways, we think that there has been a prevalent want of system in giving signals, as well as disregard of duty in not exhibiting them. To render signals efficient, they should be conducted with the *greatest simplicity* as well as certainty, and where many signs are sought to be conveyed, as proposed by the Railway Conference, there is great danger of an improper one being used. Where a signal of danger becomes necessary, it must generally occur from irregularity or accident, and we think the railway system will not be complete until provided with a ready means of immediately transmitting information to every part of the line, as by telegraph. This has been adopted on a short line in the metropolis on the electro-magnetic principle with eminent success: indeed we doubt if the business could be conducted with safety unless provided with such an instrument; an efficient means of communication is also required between the guards and engineer of the train, to give information of any accident that may occur to a carriage or otherwise.

Engine drivers are, however, placed in so important a relation to the safety and proper conduct of railway trains, that it has become a serious necessity, felt alike by the proprietors of railways and the public, that they should become or be chosen from a superior class of operatives, and it is their position to which we wish to call more immediate attention. To attain this object it is indispensably requisite that their moral conduct and emulation in the skilful discharge of their duties should be fostered by the due consideration of their superior officers and employers, and that they should be carefully protected from interference or injustice when acting with propriety. As a reward for merit we should recommend an honorary, rather than a pecuniary consideration. A medal, we think, would prove a more certain inducement, from its being, *after years*, a certificate of good character.

By law, engine drivers of railway trains have not hitherto been contemplated as a distinct body, nor have their duties and responsibilities been defined, except in general acts relating to all servants of railway companies, and it is to this point we think the attention of legislature may be directed with peculiar advantage; in case of accident occurring from negligence, it is of vital importance to the community at large that at any rate the delinquent should not again be suffered to risk the loss of life, the mere punishment by fine or otherwise is not enough to protect the public, and no combination of the railway interest to denounce the man as unfit for the trust is sufficient to meet the case, for unless the delinquent has been condemned by an impartial judge, fully competent to understand the case, it remains uncertain if he or some other have been guilty of the offence, and opens a door to persecution which will effectually prevent men of honourable intentions from accepting duties of so arduous a nature; it is therefore as necessary that they should be protected from injury when discharging their duties with fidelity and care, as that they should be punished when the reverse obtains, and to attain this object we should propose that men in this occupation be governed by laws in some measure similar to those enacted for the observance of pilots, to whose duties as conductors and guardians of life and property they approximate more nearly than to any other.

For this purpose it will be necessary to institute a corporation similar to that of the Trinity House, whose duty and responsibility it should be to examine and grant licences to proper persons for the conduct of railway engines, and to make bye laws for their regulation, and enforce them after approval of the Privy Council, which bye laws should be publicly exhibited for the inspection of all persons interested therein, for at least three months previous to being enforced. In carrying out the intentions of a new act of this description, it would be necessary to allow some latitude in the granting of licences to those who are at present engaged as engine drivers. In future, however, those entrusted with the charge of engines might be divided into three classes, viz., 1st, engine drivers; 2nd, engine drivers or stokers; and 3rd, apprentices; the two former should always accompany the engine, and perhaps the apprentice also, whose instruction should, however, in part consist of mechanical knowledge acquired in the workshops; as fitter each man should derive his authority to act in either capacity by licence, stating the grade to which he belonged, granted after due examination and certificate on oath of the examining officer, which licence should be renewed every year. Each apprentice should serve five years before he becomes eligible to receive a licence as second engine driver, and each second engine driver should farther serve three years before he is entrusted with the entire command of an engine as first engine-man, when he should execute a bond for securing obedience to the bye-laws. An annual premium should be paid for each licence, to defray the expenses of carrying out the act, and the surplus be carried to a fund for superannuated and infirm drivers, which fund should be also provided for by a per centage of (say) sixpence per pound retained from their earnings when employed. All appointments should be registered. Licences should be revoked, annulled, or suspended by the engineer-in-chief, and those suspended may appeal to the corporation.

No unlicensed person should take charge of any engine, under a penalty. The description should appear on his licence, and none be allowed to act until registered, or without producing his licence. He should deliver up his licence when required, and be liable to penalty for acting when suspended. He should be liable for lending his licence, for drunkenness or misconduct. Drivers quitting without consent should be liable to penalty, and a penalty should be enforced on railway companies for employing unlicenced engine drivers. Penalties should be appropriated to a relief fund. It would not, however, be a sufficient security to the public that the engine drivers only be made subject to these or similar regulations, it is imperative that all other servants connected with the transmission of trains should be subjected to similar regulations and strict definition of respective duties.

We think it has been far too frequently the practice to allow blame to be cast on the engine drivers, rather than sift to the bottom who may have been the real delinquent, and it has been lost sight of by the public, that perhaps eight out of ten of the late disastrous accidents are not wholly attributable to their negligence, and that such a groundless charge against a body of men when endeavouring to exert their utmost abilities, is calculated to cause a bad moral influence, and debar intelligent persons from accepting a situation where no protection is afforded.

DRAINAGE BILL.

We have long wished that some measure should be brought forward to provide an efficient system of architectural police, and we are pleased to see at last some hopes of this being effected. In the hands of the architect and the engineer to a great degree are left the health and happiness of the population, and this is particularly the case in large towns. The medical man does but follow, for the responsibility lies more on the architect than on any one else. Most of the requisites for health depend on the due administration of his duties, food is supplied by others, but he has to provide lodging, water, drainage—nay, it may be said, even air. If we want to appreciate how great is this responsibility, let us take two cases from this metropolis, we will take the western or Kensington division, and the eastern or Whitechapel division, in the former the annual average of deaths is 2·2 per cent., in in the latter 3·4 or more than 50 per cent. higher, a result attributable mainly to the want of drainage and to the bad mode of construction. In Whitechapel there are as many as four females in a hundred who die in a year, an average as low as that of Lisbon, while as we have seen, in another part of the metropolis the average is little more than one half. It is not our purpose at present to enter at any length into this subject, for we presume that our readers must be too well aware by experience of the main facts—we here however state it as our decided conviction that one-third of the deaths in this metropolis, causing an annual loss of TEN THOUSAND LIVES, is mainly owing to the inefficiency of our architectural police, and let it be remembered that London is one of the healthiest cities in the world, that even the great partial mortality of which we have spoken is nothing to that of Dublin, Manchester, Glasgow or Birmingham—still in the last ten years One Hundred Thousand Lives have been sacrificed in this metropolis of civilization through the ignorance of the public, and the negligence of the legislature.

Upon the architect, we have explained, that there devolves a high share of responsibility, that upon the due discharge of his duties the health of his fellow-citizens is dependent, we therefore say that it is incumbent on the profession not to be supine under such circumstances, but to give every aid in their power towards remedying the evils which have sprung from a bad system. The proper fulfilment of these onerous duties gives the architect a high claim upon the public sympathy, and must tend to raise the moral and social position of the profession. The architect ceases to be an artist, whom we call in to minister to our luxuries, or a mechanic, whose brick and mortar services we can cheaply pay, he comes before us in another capacity, he has more weighty cares, and the public will not only give him a larger share of their esteem, but a greater measure of power. It is to instructed men that the public have to look for the efficient direction of a proper system, and to no other hands can it be satisfactorily confided. We therefore call on the profession in the consideration of this important question to dismiss their private interests, and to consult only their public obligations, to look with kindness at measures calculated to elevate the dignity of their pursuits, and to see defects only for the purpose of giving every assistance to amend them.

We confess that the consideration of recommendations, such as those contained in the Drainage Bill, is to a certain extent involved in difficulty, for an interference with existing modes is evidently calculated to disturb and seriously injure many private interests. By the proposed enactment the landed proprietor will not be allowed to build as he likes, he will be put to expenses which he would be anxious to avoid, and he will not be able to make as much as he formerly could of his property. This is the first feeling suggested on reading the bill, but we should take but a narrow view of the question did we limit ourselves to such a view. There are other private interests concerned besides those of the holder of building ground, there are the interests of all classes of the community which are affected by the bad working of the present system. Let us suppose that in the midst of Pimlico or the Regent's Park, among houses in which every comfort has been studied, a small plot should be left unbuilt, it is clearly in the power of the owner at present from the demand for habitations created by the population already established in the neighbourhood—it is clearly in the power of the owner, we say, to establish a pernicious fever colony in the midst of the most healthy district. In his anxiety to make the most of his property he may, as others have done, build a nest of houses, back to back, with narrow alleys, no thoroughfare, and without drainage, and without provision for the removal of filth of any kind, or he may do worse by letting all the refuse fill one open drain. Let the windows be small and immoveable, the rooms of the most cramped dimension, let him fill these houses with those who are unfortunately competitors for the worst accommodation, and malaria will do the rest—fever will spring up in the devoted district, the houses of the poor will be desolated, death will do his work in every house, ten, twenty, thirty cases of disease in one habitation—the leaven has worked, and pestilence will go abroad to carry its warfare among the rich and the beautiful, and teach its awful lesson of the common interests and common liabilities of human nature. This is no exaggerated picture, no effort of the imagination, we can point out the districts, name the houses, number the victims,—a fever map of the metropolis would be dotted with black and livid colonies of death—here is the active volcanoe, here is that which has had its day of ravage and now slumbers for awhile—in that darkened alley, where there is scarcely a pathway for the solitary visitor, sixty cases of fever have broken out at once—that row of lodging houses forms one perpetual hospital, the surgeon is never absent from its doors, the hearse is a punctual visitor. All the evils, which we have depicted, may be brought about by ignorance or negligence, and there is no remedy, except at the expense of the victims. The sewers are made from the general rates, the union officer is sent to cure the sick, the weakened labourer, the widow and the orphan become burthens on the poor rates, the public slumber, another crop is prepared for the scythe, the same scene is repeated, and still we remain inactive. It would be no exaggeration to say that the portion of poor rates in Marylebone immediately attributable to fever colonies is not less than twenty per cent., a heavy penalty for private cupidity and public negligence. It is therefore no valid interest for which the landowner would ask protection, he has profited by a public wrong, and on the remedy of that evil he must abide the consequences, were they more severe then they are likely to be, while he will equally profit by the public advantage. The results to be expected from an efficient system of architectural hygiene are a diminished rate of mortality among all classes, and a considerable reduction in the poor rates —advantages, we presume, in the contemplation of which all private interests must sink in the scale. The amount of poor rates for the metropolis alone is above half a million, a sum the diminution of which cannot fail to be a boon, while it will furnish a good set-off against any expenditure which may be necessary under the new arrangements. In the profession, as regards personal interests, the same compensation will be the result, if any loss should be sustained by the builders of low class houses, yet there is again in the increased activity given to other departments.

Taking up the bill itself, under these circumstances, and considering that it has yet to pass through committee, we shall bear but slightly upon its individual details, for although many of them are highly objectionable, yet as a general feeling prevails that they will be amended in the further progress of the measure, it would be but wasting the time of our readers. The first clause by including every borough and market town, necessarily takes in many places of small population, in which the proposed enactment would be unnecessary, we should therefore suggest, that there should be a general limitation, to the wording of the clause any borough, market town, town or village, having more than —— thousand inhabitants. We certainly think that it is but equitable that those proposing to build on any property should provide it with proper sewers; streets are as much for the public as for private use, but sewers are more for private use than for that of the public. The second clause, which is retrospective, and requires drains to be made for unprovided houses now existing, we think bears particularly hard upon the occupier, and we hope will receive due modification. The third clause provides for the alteration of foundations on rebuilding old houses, and though it will prove burthensome, is a necessary consequence of the general tenour of the bill. The seventh clause gives a usual and necessary power to commissioners of sewers to open any private drain, and the eighth, power of compulsory cleansing of drains, water-courses and cesspools. The seventeenth clause provides for the inspection of all proposed buildings by the surveyor, who is to see that the provisions of the act are complied with, fixing a maximum fee of 3*l.* 10s., and a minimum of 15s. The nineteenth section enacts that houses are not to be built below the level of the ground without areas. The 20th clause declares that no close court shall be built nor any of less width than 20 feet; the Marquis of Northampton who has already alluded to the subject, will probably move as an amendment that the width of alleys and streets be regulated by the height of the houses. By the succeeding clause houses may not be built back to back. The 23rd section says that walls shall be founded on concrete; the 24th that the level of the ground floor shall be at least 18 inches above the level of the footway or road adjoining, and air bricks shall be built in the walls 9 inches below the level of the floor, so as to allow of the free circulation of air beneath. The 25th section is the one, which has excited the most attention; it provides that no room in any house having only one room on the ground floor, or having only four rooms in all shall be less than eight feet in height, and that in every such house there shall be at least one room 12 feet by 12 in the clear. The next section provides that every room containing 144 square feet of flooring shall have at least one window of specified size, which admits of being opened freely. The restriction as to height and breadth appears to be bad, as the object might be answered effectually by requiring a superficies for windows of 14 square feet and a quarter. The 27th clause declares that cellars shall not be occupied as dwellings, but it seems very difficult at present to carry such a provision into effect, for in Liverpool there are 35,000 persons living in cellars, and in Manchester 15,000, a population which it would be inconvenient suddenly to dislodge.

By next month the bill will have assumed a more tangible form, and we shall then be enabled to consider in what way the clauses will bear on the profession, but at present, with the prospect of extensive modifications, we feel that this labour would be useless.

THE HALICARNASSIAN MARBLES.

THE attention of the learned world has lately been much attracted to the precious remains of ancient art still existing in Asia Minor. The researches of the Dilettanti Society had contributed not a little towards a knowledge of some of its architectural monuments: and the labours of Captain Beaufort had opened the means of acquaintance with the southern coast. But it was not until the publication of the travels of Mr. Fellows, in 1839, that the public became aware of the extent of the treasures that exist in that most important part of the ancient world. In consequence of the interest excited by his work, Mr. Fellows was induced to return to that country, under the auspices of the Geographical Society; and we are informed that the result of his journey has been the acquisition for the British Museum of some sculptures of a most valuable character, from Lycia; and the construction of a correct map of a portion of classic ground which Lieutenant-Colonel Leake describes as "a complete blank." So little was known of the interior of Asia Minor, that it was left for Mr. Fellows to make the discovery of various cities of great extent, with whose very names no previous acquaintance had existed, among which one may be particularized numbering a population of not fewer than 30,000 souls. We trust that the result of these researches will soon be brought before the public. In the mean while it is our present purpose to solicit attention to the fact of the existence of some highly valuable remains of antiquity at Halicarnassus, the ancient and celebrated capital of Carya, in order that advantage may be taken of our present favourable position with regard to Turkey, and that, while our fleet is in the immediate neighbourhood, the sculptures in question may be rescued from the ignorance and barbarism of their present possessors.

Halicarnassus was situate on the coast of Asia Minor, near its south-western extremity; and, upon the death of Mausolus, the King of Carya, B.C. 330, it became remarkable as the site of that famous monument erected to his memory by his Queen Artemisia, which gave the name of Mausoleum to all similar structures, and which is so elaborately described by Pliny. The present name of this place is Boudroun, and it forms a part of the province of Anatolia or Anaboudl. Boudroun appears to be, through the term Petrumi, as the Turks write it, a corruption of Pietro, or "Castellum Sancti Petri." The best account of this spot and its antiquities, with which we have been able to meet, is that contained in *Dr. Clarke's Travels*, vol. iii., pp. 256 and 268. In a note on the latter page, he says, "We are indebted for the information which follows, concerning Halicarnassus and Cnidus, together with the plan which accompanies it, to the observations of Mr. Morritt, celebrated for his controversy with Mr. Bryant on the subject of Homer's Poems and the existence of Troy. It is the more valuable, because few modern writers have visited these ruins; and certainly no one better qualified for the undertaking :—

"June 14, 1795.—We set out in a boat from Cos, and in a few hours reached Boudroun, the ancient Halicarnassus, a distance of 18 computed Turkish miles. This small town stands on a shallow bay, at the eastern extremity of the large and deep port of the ancient city. Off this bay lies the island mentioned in Strabo by the name of Arconnesos, Αρκοννησος. (Lib. xiv., p. 656.)

"June 15.—We tried to procure permission from the disdar, the Turkish governor of the castle, to see the interior of that fortress; but after a long negotiation we were at last only permitted to walk with a janissary round the open ramparts, his jealousy not permitting the inner gates to be opened into the court. The castle is a work of modern date, but built in a great degree of ancient materials, confusedly put together in the walls. There is a plate which gives a correct notion of its general appearance in the *Voyage Pittoresque*. We found over the door an ill-carved lion, and a mutilated bust of ancient work. Old coats of arms, the remains probably of the Crusaders and the knights of St. John of Rhodes, are mixed in the walls with many precious fragments of the finest periods of Grecian art. There are several pieces of an ancient frieze, representing the combats of Theseus and the Amazons, of which the design and execution are equal to those which Lord Elgin brought over from the Parthenon. These are stuck in the wall, some of them reversed, some edgewise, and some which have probably been better preserved by having the carved side towards the wall, and inserted in it. No entreaties nor bribes could procure these at the time we were abroad; but now, if they could be procured, they would form, I think, a most valuable supplement to the monuments already brought hither from Athens. From my recollection of them, I should say they were of a higher finish, rather better preserved, and the design of a date somewhat subsequent to those of Phidias, the proportions less massive, and the forms of a softer, more flowing, and less severe character. It is probable that these beautiful marbles were taken from the celebrated Mausoleum; of this, however, no other remains are discoverable in those parts of the town we were permitted to examine. I found an inscription this day, near a fountain in the town, containing hexameter and pentameter lines, on the consecration or dedication of some person to Apollo."

In allusion to the same subject, Captain Beaufort has remarked, "Numerous pieces of exquisite sculpture are inserted in the walls, representing funeral processions, and combats between clothed and naked figures."

The Bay of Marmorice, where our squadron is now wintering, is in the immediate neighbourhood of Boudroun; and the facilities arising from this circumstance have produced much anxiety that the attention of the Government should be called to the facts thus briefly adverted to. In compliance with a memorial on the subject from the Architectural Society, Lord Palmerston recently granted the honour of an interview to a deputation from that body, at which the president, Mr. W. Tite, and the secretary, Mr. Grellier, laid before his Lordship a statement of all the authorities they had collected upon the existence and present condition of the remains under consideration. His Lordship promised that he would write to Lord Ponsonby and Admiral Stopford on the subject; and we have only to express our hope that his negotiation may terminate in the acquisition of these sculptures for our national museum, where they will form a noble link in the chain of Grecian art, and compensate in some measure for the loss of the Phigalean and other marbles.—*Times*.

[In addition to the foregoing extract from the *Times*, it will be seen by the correspondence which we have subjoined, that the Institute has not been behindhand in taking up this subject. We are gratified with the prospects which arise from Lord Palmerston's active and kind interference.]

Copy of a Letter from the Royal Institute of British Architects to Lord Palmerston.

My Lord—The Institute of British Architects, having become acquainted, through some of its members who have visited Boudroun, the ancient Halicarnassus, that there are several fine specimens of Grecian sculpture inserted in the walls of the Castle without any regard to the danger they incur in such a situation, are induced to submit to your Lordship that it is most desirable to take advantage of the present favourable epoch for obtaining, if possible, the accession of these valuable relics of antiquity to our national collection, for their rescue from the degradation and destruction to which they are now exposed, and for the advancement of British art. In addition to the feeling which the members of the Institute entertain in common with others connected with the fine arts on the subject of these marbles, they attach the greater interest to their acquisition from the circumstance that they originally formed the decorations of a celebrated structure of ancient Greece.

The Council of the Institute further presume most respectfully to suggest to your lordship, that in the event of Her Majesty's government applying to the Sublime Porte for these sculptures, it would be desirable, at the same time, to request an authority to search for, and remove other remains of ancient art on that site and others on the coast of the Levant, where numerous valuable relics are well known to exist; and should this suggestion be entertained, the Institute, through its members who have visited the localities in question, will have much pleasure in contributing every information and assistance in their power to promote an object so important.

We have the honour to be,
Your Lordship's most obedient and humble servants,

C. Fowler, }
A. Poynter, } *Hon. Secs.*

The Lord Palmerston.

(Reply.)

Foreign Office, Feb. 9, 1841.

Gentlemen—I am directed by Viscount Palmerston to acquaint you for the information of the Members of the "Royal Institute of British Architects" that in compliance with the request contained in your letter of the 29th ultimo, his Lordship has instructed her Majesty's Ambassador at Constantinople to endeavour to obtain the permission of the Porte, for the removal of the ancient sculptures at Boudroun, mentioned in your letter, and also for the removal of the other marbles in the neighbouring districts alluded to in your letter.

I am, Gentlemen,
Your most obedient humble servant,
J. Backhouse.

C. Fowler, Esq., and A. Poynter, Esq.

THE COMMERCIAL DOCKS AT SOUTHAMPTON.

This central port, considered in its adjacency to the ocean, is at the same time, the most convenient for commerce. It has the Isle of Wight for a breakwater, with entrances on the west, by the Needles—on the south, by Spithead and the Mother Bank, with the Waters of the Solent for a sheltured outer anchorage. The harbour itself is most admirably fitted for the accommodation of trade, being ten miles in length, four miles above, and six miles below Southampton, with a wide and abundantly deep channel and the best anchorage. Nature has likewise provided a situation peculiarly fitted for commercial docks, at the very foot of the town of Southampton, and immediately contiguous to the South Western Railway, the connecting link between this noble harbour and the river Thames: the site of the docks, 208 acres in extent, is accessible on three sides, by the river Itchen and Southampton water—the most protected side being the margin of the Itchen—where the water is 12 feet, low water spring tides, and which is being dredged to the depth of 18 feet.

One of the docks now in progress, is intended to be opened at the expiration of six months or thereabouts, which will contain 16 acres of water, of the depth of 18 feet, low water spring tides, open at all times of tide, with an entrance of 150 feet in width, avoiding the expense of constructing and working entrance locks, and preventing any occasion of delay in entering or departing. To these important considerations, never before combined in any similar enterprize, is to be added, that the wharf ground, between the northern frontage of the two docks to be first constructed and the town, is of a description so ample as to admit of goods being lodged or housed in large quantities, under sheds and in warehouses, having vaults and a ground floor only, or of being otherwise so constructed as to require bnt little cranage.

The inducements to resort to these docks may be thus explained—first, as to the merchant of Liverpool,—second, as to the merchant of London.

1. As to the merchant of Liverpool.

It is well known that a given value in exports from Lancashire is comprehended in much less bulk than the same value invested in the produce of the countries to which the outward cargoes are exported, and that the colonial or other produce imported in return, is of much greater amount than is required for the market of Liverpool. The surplus is, in part, now consigned to London, but it must be obvious that provided as good a market can be found at Southampton, the merchant of Liverpool will prefer that port to London, for the following reasons.

1. The more early arrival of the vessel at its destination.

2. The smaller expenses of the port, in pilotage, light duties and other charges.

3. The nearer proximity of Liverpool, should the vessel be required to load outwards at that port; or if not, the shorter voyage to its ultimate destination, if down channel.

These reasons may be considered as conclusive, provided there be an equally good market for the inward cargo.

With reference to that question, it may be stated, that two millions and upwards of people are now supplied with grocery, fruits both green and dry, and other imports, first carried past the Port of Southampton, to encounter the delays, and be incumbered with the expenses of the navigation to and at the Port of London—which delay and expenses are doubled in conveying back these goods to the ports of the English channel, between Newhaven and Falmouth. Thus are two millions and upwards of the inhabitants of England now supplied with articles of import, instead of this merchandize being landed at Southampton, to be distributed with the greatest facility, weather permitting, to the Isle of Wight, and the numerous ports on the channel, Newhaven, Chichester, Portsmouth, Lymington, Poole, Weymouth, Bridport, Lyme, Dartmouth, Exeter, Teignmouth, Plymouth and Falmouth. That the merchant of Liverpool will be most anxious to profit by this opportunity of sharing, more largely, at an easy expense, in the supply of the markets of the south-west of England, cannot be doubted, and that he will therefore freely use the port of Southampton, may be considered as certain.

2. As to the merchant of London.

He has also to consider how to deliver goods to the consumer with the greatest despatch and encumbered with the least expense. Even supposing him to determine not to deviate from the old and beaten tracks of business, the effect must be, the abandonment of the markets of the South West, to the activity and enterprize of the merchant in the North West of England. Such a case, however, will not arise, nor will the merchants of London be slow, although some may be unwilling, to avail themselves of the means of despatch, economy and other advantages attendant on the adoption of Southampton as a branch port.

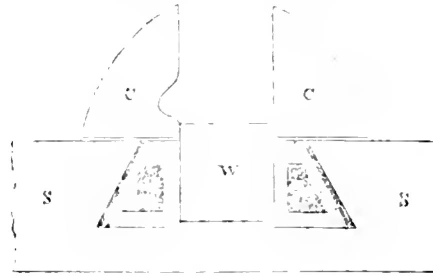
Nor are the inducements to prefer the Port of Southampton confined to the home trade. The large quantities of merchandize now brought to the Port of London to be re-shipped for colonial and foreign markets, will find a cheaper and more convenient depôt at Southampton, and especially the extensive class of imports from Java, the Brazils, Havannah and other foreign states or possessions, destined for foreign consumption, will, as matter of course, be carried to that port which can be the soonest reached, is the least expensive and the best situate for general distribution to the consumer, and such will be the Port of Southampton, being, at the same time, not less adapted for the collection of the outward cargo, now brought into the Port of London to be carried out again at a heavy expense.

The dock intended to be opened in September next, is to contain, as already mentioned, 16 acres. The second dock, also in progress, which is to be a close dock, will contain 14 acres of water—the whole of the enclosure of land and water, for these two docks, will comprehend about 60 acres, affording an extent of accommodation capable of yielding, if fully employed, at the rates charged by the docks of London, a nett income of £150,000 per annum, upon an outlay of £500,000 or thereabouts, of which it is proposed, agreeably to the provisions of the Act incorporating the Company, to borrow £150,000. There would then remain to be enclosed 140 acres more of the dock land. It would be premature to indicate by more than a slight sketch the probable occupation of that part of the site. It may, however, be shown, that there are easy, cheap and profitable means of using this ground so soon as sufficient trade shall have been attracted to Southampton to justify an extension of the works already undertaken. About 90 acres of the 140, running south of the present works would furnish ample accommodation for a trade in timber and coals—by being divided into two parts—a dock for timber ships and colliers, and an enclosure for timber ponds, where timber both afloat and in stack, might be bonded to a great extent. The then remaining part of the dock land would be about 50 acres, on the western side, bounded by Southampton water, a situation admirably calculated for a second close dock, should it ever be required. The works of the first or tide dock are far advanced,—it is intended to be opened to the merchant and shipowner in the month of September next; the second or close dock will require another year.

The Royal Mail Steam Packet Company is under engagement to work to and from this dock. The extensive trade now conveyed by the Peninsular Steam Packets has already located itself at Southampton, several ships run to the Mauritius from this Port for sugar, and it is well known that large commercial capitals both of London and Liverpool employed in the East and West India trades are awaiting the accommodation of these docks, in order to avail themselves at the earliest moment, of the advantages of supplying the large and flourishing population of the South West of England on terms with which it will be impossible to compete, by subjecting merchandize (in bringing it to London) to an average delay not to be estimated at less than one month (including the two passages), and at the same time to the heavy and oppressive expenses of the Port of London, and of its export from that Port, for distribution for domestic and foreign consumption.

Ice-cutting Steam-boats.—Letters from Copenhagen of the 18th ult. state, that M. C. M. Hjorth has just resolved a problem which, for upwards of ten years, has vainly exercised the sagacity of naval engineers—and whose solution has more than once been proposed for competition, as well by the General Administration of Posts, as by the corporation of merchants in the capital. He has invented a steam-boat capable of cutting its way through the thickest ice, with a speed nearly equal to that of its unimpeded navigation. The General Administration of Posts have received a most favourable report from a committee of ship-builders and machine-makers, to whom they had submitted the model, and have applied for authority to construct a vessel for the transport of the mail during winter.

HARPER'S PATENT RAILWAY CHAIRS.



Perspective view of improved chair.
C C. Cheeks of chair; W. Oak wedge upon which the rail rests; S S. Sleeper.

The annexed engravings represent the patent chair which has been introduced on one hundred yards of the South Western Railway, about half a mile below the Winchester station, in November 1839, since then the down trains have regularly passed over them.

The resident engineer, Edward Dixon, Esq., has favourably reported upon them several times down to the 28th of December 1840, the following are extracts from his reports.

"The principle is good in doing away with the use of spikes, and the enormous injury arising from the splitting of sleepers by boring and spiking. I have not paid sufficient attention to speak decidedly as to the difference of noise, but the result should certainly be favourable."

"I should like to see it laid on a large scale, as it has several advantages over the present method."

"I do not think any of the chairs laid down broke in the fixing, and none have broken since, I consider them less liable to breakage than the old chairs, there being no spikes to drive in, the risk is reduced, and in keeping the rail after the chair is fixed, there would be less chance of breakage from a miss-blow of the keying hammer striking the cheek of the chairs, on account of the wood which holds the chair in its place allowing of a little elasticity."

The Directors of the above Company have assented to an application made by Mr. Harper, and the engineer-in-chief Joseph Locke, Esq., has fixed for a further trial to be made on the Gosport Branch, near Winchester.

The saving of expense is stated by the patentee to be nearly 300*l.* a mile, exclusive of any estimate for advantages derived.

CHIMNEY POTS.

Sir—A correspondent, J. R. B., in your last number, as a remedy against the unsightly but unfortunately not altogether uselessness of chimney pots, (although never applied as they only ought to be), calls on builders to try the experiment of flues in the form of a tin coach horn, with the large end upwards. I am quite inclined to believe that such a trial would be successful, but if applied to the whole length of (say) a 40 feet flue, as I understand him to intend, any useful difference in its diameter would, I fear, so swell the stack, as, if conveniently practicable, would at once banish the beautiful shafts of the old English style, and lead, in too many instances, to no very sightly substitutes in that or any other style. What if the principle were applied to the last five or six feet merely; even then it might perhaps lead to deformities too frequently; this however is a secondary consideration, and the genuine architect can never be at a loss to get over such a difficulty, since it is his business to surmount difficulties, and therein prove his superiority to mere pretenders.

J. R. B. will perhaps favour us with his experience in, and valuable remarks on, the practicability of his suggestions.

I am, Sir, your obedient servant,

G. W. E.

February 16, 1841.

ENGINEERING WORKS OF THE ANCIENTS, No. 2.

Continuing our notes from Herodotus, the present paper will principally relate to the Egyptians, whose works like those of the Babylonians, have an interest for us, as giving rise also to a school on which Greek engineering was founded. It is one of the most ancient of which we possess authentic monuments and records. The Egyptians like the Babylonians principally devoted themselves to hydraulic engineering, in which they made great progress; their other works also afford convincing proofs of their attainments in other departments of the art. The account of Egypt in Herodotus might be almost termed a history of engineering in that country, where it was called into play as one of the great instruments of national advancement, the exploits of a prince consisting as much in the works he executed, as in the victories which he obtained. This is one of the features of a system of polity, to which Egypt was indebted for great social progress, and an exemptiom from many of the evils which afflicted surrounding nations. If from moral causes Egypt never attained the intellectual perfection of the Greeks, yet by the extent of its public works the country was brought into a high state of cultivation and productiveness, so as to make it for centuries the granary of Europe. It was less owing perhaps to the fertility of the soil, than to the facilities afforded as to internal communication, that the resources of Egypt were made so extensively available.

CAUSEWAY OF CHEOPS.

Cheops, it is said by our author, degenerated into extreme profligacy of conduct, and oppressing the Egyptians in every way, he proceeded to make them labour servilely for himself. Some he compelled to hew stones in the quarries of the Arabian (query) mountains, and drag them to the banks of the Nile; others were appointed to receive them in vessels and transport them to a mountain in Libya. For this service a hundred thousand men were employed, who were relieved every three months. Ten years were consumed in the hard labour of forming the road, through which these stones were to be drawn; a work cited by Herodotus as equal in difficulty to the pyramid itself. This causeway was five stadia in length, forty cubits wide, and its extreme height thirty-two cubits, the whole of polished marble, adorned with the figures of animals. So far our author, a modern account by Pococke and Norden, says that there is still a causeway running part of the way from the canal which passes about two miles north of the pyramids. This extends about a thousand yards in length, and twenty feet wide, built of hewn freestone. It is strengthened on either side with semicircular buttresses, about fourteen feet diameter, and thirty feet apart. There are sixty-one of these buttresses, beginning from the north. Sixty feet farther it turns to the west for a little way, then there is a bridge of about twelve arches, twenty feet wide, built on piers that are ten feet wide. Above one hundred yards farther there is another bridge, beyond which the causeway continues, about one hundred yards to the south, ending about a mile from the pyramids where the ground is higher. The reason for building this causeway and keeping it in repair seems to be the lowness of the country, the water lying on it a great while.

THE GREAT PYRAMID.—THE MIDDLE PYRAMID.—THIRD PYRAMID.

As we are rather giving common-place notes from the individual authors, than complete accounts of the works, we have less compunction in copying what Herodotus says of the much-written subject of the pyramids. Having described the causeway just mentioned, our author goes on to say that a considerable time was consumed in making the vaults of the hill on which the pyramids are erected. These he intended as a place of burial for himself, and were in an island which he formed by introducing the waters of the Nile. The pyramid itself was a work of twenty years: it is of a square form; every front is eight plethra long, and as many in height; the stones very skilfully cemented, and none of them of less dimensions than thirty feet. The ascent of the pyramid was regularly graduated by what some call steps and others altars. Having finished the first flight, they elevated the stones to the second by the aid of machines constructed of short pieces of wood (supposed by some to be the pulley); from the second, by a similar engine, they were raised to the third, and so on to the summit. Thus there were as many machines as there were regular divisions in the ascent of the pyramid, though in fact there might be only one, which being easily manageable, might be removed from one range of the building to another, as often as occasion made it necessary; both modes have been told me, says Herodotus, and I know not which best deserves credit. The summit of the pyramid was first of all finished off; descending hence, they regularly completed the whole. Upon the outside were inscribed in Egyptian characters, the various sums of money expended in the progress of the work for the radishes, onions and garlic consumed by the artificers.

The middle pyramid, attributed to the daughter of Cheops, is stated to have an elevation on each side of one hundred and fifty feet.

Chephren, the brother of Cheops, is mentioned as the builder of the third pyramid, which was less than his brother's. It has no subterraneous chambers, nor any channel for the admission of the Nile. The ascent is entirely of Ethiopian marble of divers colours, but it is not so high as the larger pyramid by forty feet. The pyramid stands on the same hill as that of Cheops, which hill is near one hundred feet high.

DOCKS.

Psammitichus, as a reward for services rendered in war, conferred on the Ionians and Carians certain lands, which were termed the Camp, immediately opposite to each other, and separated by the Nile. They were the first foreigners whom the Egyptians received among them; and "within my remembrance, in the places which they formerly occupied, the docks for ships, and vestiges of their buildings, might be seen," continues our author.

CANALS.—RED SEA.—SLUICE.—BOLBITINIAN.—BUCOLIC.—MEMPHIS.—AN ENGINEERING KING.—CIVIL ENGINEERS.—ENGINEERING THREE OR FOUR THOUSAND YEARS AGO.—SURVEYORS.

Pharaoh Necos, the son of Psammitichus, was, according to Herodotus, the prince who first commenced the celebrated canal leading to the Red Sea, which Darius, King of Persia, afterwards continued. The account of Herodotus is this:—The length of the canal is equal to a four days journey, and it is wide enough to admit two triremes abreast. The water enters it from the Nile, a little above the city Bubastis; it terminated in the Erythrean Sea, not far from Patumos, an Arabian town. They began to sink this canal in that part of Egypt, which is nearest Arabia. Contiguous to it is a mountain, which stretches towards Memphis, and contains quarries of stone. Commencing at the foot of this, it extends from west to east, through a considerable tract of country, and where a mountain opens to the south is discharged into the Arabian gulph. From the northern to the southern, or as it is generally called, the Erythrean Sea, the shortest passage is over Mount Cassius, which divides Egypt from Syria, whence to the Arabian gulph is exactly a thousand stadia. The way by the canal, on account of the different bends, is considerably longer. In the prosecution of this work under Necos, no less than one hundred and twenty thousand Egyptians perished. He at length desisted from his undertaking, being admonished by an oracle, that all his labour would turn to the advantage of a barbarian. Diodorus Siculus gives an account which brings the progress of the work down to the time of the Greek kings; he says:—The canal reaching from the Pelusian mouth of the Nile to the Arabian gulph and Red Sea was made by hands—Necos, the son of Psammitichus, was the first that attempted it, and after him Darius the Persian carried on the work somewhat farther, but left it at length unfinished; for he was informed by some, that in thus digging through the isthmus he would cause Egypt to be deluged, for they showed him that the Red Sea was higher than the land of Egypt. Afterwards Ptolemy, the Second finished the canal, and in the most proper place contrived a sluice for confining the water, which was opened when wanted to sail through, and was immediately closed again, the use of it answering this purpose extremely well. The river flowing through this canal is called the Ptolomean, from the name of its author. Where it discharges itself into the sea it has a city named Arsinöe. So far our authors; we may farther mention that the site of this canal, although it could not be found by Norden, was distinctly ascertained by the scientific commission attached to the French army, and that plans have been proposed by Mehemet Ali for restoring.

Of the seven mouths by which the Nile disgorges itself into the sea, two are stated to have been produced by art, the Bolbitinian and the Bucolic,* a circumstance that shows the importance which the Egyptians attached to ready access with the sea, as a means of promoting their maritime commerce. This, fostered as it was by the extent of inland navigation, was, whether in the hands of foreigners or natives, carried on upon a large scale, embracing not only domestic productions, but also the transit trade with India and the East, of which Egypt was so long the channel, and the value of which, as our subsequent observations will show, was appreciated at an early period. It is true that these two canals were also required for agricultural purposes, but we think we do not err in attributing also another motive. The order in which the seven branches of the Nile lie from

* Herodotus Euterpe.

east to west, which will show the position of the artificial branches, is thus; the Pelusian, the Mendesian, the Bucolic, the Sebennitic, the Saitic, the Bolbitine, and the Canopic.

One of the earliest hydraulic operations to which we find allusion made, was the recovery of the site of Memphis from the water by which it was overflowed. This is attributed to Menes, respecting the date of whose reign some diversity of opinion exists, Herodotus calling him the first sovereign of Egypt, while by Diodorus Siculus, he is styled the first king of Memphis, a view which is supported by many leading moderns. According to Herodotus the river before that time flowed entirely along the sandy mountain on the side of Libya, but by Menes its course was diverted. A hundred stadia from Memphis a bank was constructed, while a canal was led between the mountains, or according to some cut through them, to receive the stream. Of the ancient bed the site is still to be traced; Savary observes that it may be found west of the lakes of Natroun, extending for a considerable distance. Menes is also said to have sunk a lake to the north and west of Memphis, communicating with the river, which from the situation of the Nile, it was impossible to effect towards the east. On the spot thus rescued from the water was built the city of Memphis, by which Thebes was afterwards supplanted. We have here an instance at an early period of the diversion of a large river, and the recovery of a considerable space of ground, operations requiring a degree of skill in the plan, and energy in the execution which must give us a favourable idea of the engineer-king, who thus founded a city and a dynasty. It might at this place be a speculation whether it was not to the success of this work that Menes and his followers owed their kingdom and their authority, an hypothesis which if substantiated would be a unique addition to the claims of the profession. Cultivated as it has been by kings and warriors, it shares this honour with the law, with which the establishment of this new fact would give another step towards an equality of privileges—many owing their kingdoms to their legislation, and acquiring the exercise of authority by showing the necessity for it. Homer mentions the practice of medicine by powerful chiefs, but this art although it may have saved crowns, never seems to have gained them. We have however another subject of interest to the profession to lay before them—suggested also by the works of Menes. Our author informs us that even in his time, when Egypt was under the dominion of the Persians, the artificial channel was annually repaired, and regularly preserved; for he says had the river once broken its banks, the town of Memphis would have been greatly endangered. The necessity for the regular preservation of these works would undoubtedly require their being placed under the care of duly appointed officers, the exercise of whose functions being specially devoted to one object would lead to the formation of a particular class, essentially civil engineers. The same class of officers would also be required in other parts of the country, and thus we may conceive the organization at the distance of two milleniums and a half of a regular *water staat*. We have here a dawning of the system of a government corps of engineers, such as exists in most countries abroad at this moment, for there must have been in Egypt little opportunity for private practice when so much depended on the government. Private practitioners of engineering, although employed by governments, we shall perhaps hereafter find to have sprung up in Greece—so much split up in petty states, many of which would have no demand for permanent officers.

A princess, whom Herodotus calls Nitocris, is said by him to have floated to death a number of Egyptians. Having been appointed sovereign on the death of her brother, who had been murdered by the Egyptians, to be revenged on them she had a large subterranean apartment constructed, to which she invited a great number of those, whom she knew to be the principal instruments of her brother's death, and then by a private channel introduced the water of the river among them, and so destroyed them.

To Sesostris is attributed the execution of the general system of canals with which Egypt is provided, the number of which still existing is estimated by Savary at eighty, several of which are fifty, eighty, or a hundred miles long, and like rivers. On the return of Sesostris from his foreign conquests about three thousand two hundred years ago, he employed the captives of the different nations in collecting the immense stones which were employed in the temple of Vulcan. They were also, says our author, compelled to make the vast and numerous canals, with which Egypt is intersected. In consequence of their involuntary labours, continues the historian, Egypt which was before conveniently adapted to those who travelled on horseback or in carriages, became unfit for both; the canals occurring so often, and in so many winding directions, that to travel on horseback was disagreeable, but in carriages impossible. The inhabitants of the inland parts however benefited by obtaining a more regular supply of water for domestic and agricultural purposes.

In his next paragraph Herodotus informs us of the well known origin of surveying. Sesostris made a regular distribution of the lands, and assigned to each Egyptian a square piece of ground. Whoever was a sufferer by the inundation of the Nile, was permitted to make the king acquainted with his loss, and certain officers were appointed to inquire into the particulars, that no man might be taxed beyond his means. To this circumstance the historian assigns the origin of geometry, and from Egypt it was afterwards communicated to Greece. Here we have the origin of surveying, and of distinct officers engaged in its pursuit at a period according to received chronology, about 1350-60 years before Christ, now three thousand two hundred years, an antiquity, of which few professions are able to boast the equal, and one of the many circumstances in the history of civil engineering which show its early progress. Thebes was then the great school of Egyptian learning, and where geometry and surveying are supposed particularly to have flourished. It was perhaps to the government surveyors that the care of the canals of Memphis and other places was intrusted, so that then as it frequently is now, the surveyor might have been the probationer to the civil engineer. We do not apologize for troubling our readers with these observations, for we know that they like ourselves must feel the same interest in remembering that our's is no profession of to-day, but one which centuries ago, as now, was a powerful contributor to the progress of civilization, and the well being of the human race.

FOUR AND SIX-WHEELED ENGINES.

Sir—There is a subject connected with the question of four and six-wheeled engines as to their relative advantages when traversing curves, which has not, I believe, been sufficiently examined into; will you allow me, therefore, through the medium of your valuable journal, to call attention to it.

It has generally been assumed, because the distance between the fore and hind wheels is greater in six than in four-wheeled engines, that there must of necessity be greater danger of the former running off the rails when traversing curves.

If the engines moved with mathematical precision in the path laid out for them, this would undoubtedly be the case; but in consequence of the irregularities and inequalities of the rails, and the play which it is necessary to allow on this account between the wheels and the rails, the motion of the engine is varied from its true direction. Any person who has observed the action of a locomotive when passing rapidly along the rails, will have noticed that its track is not straight, but partakes of a serpentine movement, the fore wheels going from side to side in tolerably regular vibrations, and the greater the velocity the greater this effect, also the less the distance between the fore and hind wheels the greater this effect; for as the play is the same in all cases, the angle formed between the direction of the rails and the engine during these vibrations, will depend on the distance of the points of bearing; and it is probably in some measure attributable to this effect that four-wheeled engines have been found to go off the rails when travelling over straight parts, while such an accident was never, I believe, known to occur to a six-wheeled engine, unless from some foreign cause.

The distance between the centres of the wheels in the one case is about 7 feet, and in the other about 10 feet, and the play given to the wheels is half an inch. The greatest obliquity, therefore, that the six-wheeled engine can take up is ·5 of an inch in 10 feet, or 1 in 240, while in the four-wheeled engine it is ·5 of an inch in 7 feet, or 1 in 168. It would, perhaps, be too much to assume that the engine vibrated to the whole of this amount, but, to be quite on the safe side, we will take half of it, in which case the sine of the angle of obliquity between the direction of the engine and that of the rails will be expressed by $\frac{1}{480}$ in the six-wheeled engine, and $\frac{1}{336}$ in the four-wheeled engine, when travelling on the straight parts; and it will be seen that this apparently slight difference gives the advantage to the six-wheeled engine in all curves used in ordinary practice.

The sine of the angle at which an engine meets the rails on a curve supposing the engine to be moving mathematically true, will be $\frac{l}{2\,r}$, l being the distance between the centres of the fore and hind wheels, and r the radius of the curve in feet. The advantage in favour of the four-wheeled engine in this respect, on curves of the same radius, would therefore be as $\frac{7}{2\,r}$ to $\frac{10}{2\,r}$; but to this must be added in practice the angle of obliquity due to the vibratory motion of the engine;

hence, when both engines are in their most disadvantageous positions on a curve, the sines of the angles they form with the rails will be nearly as $\frac{7}{2r} + \frac{1}{336}$ to $\frac{10}{2r} + \frac{1}{480}$, and when these angles are equal to each other, we have $2r + \frac{1}{336} = \frac{10}{2r} + \frac{1}{480}$, or $r = \frac{161280 \times 3}{288} = 1680$ feet $= 560$ yards. That is to say, that supposing the deviation from the true position of the engine, due to the play between the wheels and the rails to be no more than a quarter of an inch in its length, the six-wheeled engine meets the rails at a more favourable angle, and is consequently less likely to run off them on all curves in which the radius exceeds 560 yards; on curves of a less radius the four-wheeled engine begins to have the advantage.

I am, Sir,
Your obedient servant,
W. H. Barlow.

Brereton,
Feb. 6th, 1841.

IMPROVEMENT ON ECCENTRIC RODS.

Sir—Among the numerous readers of your highly esteemed Journal perhaps there are many to whom the subject of this communication will appear of little importance, I therefore apologize for once more imposing it upon your pages.

In your present month's number (page 66,) I observe a communication signed H. E., in which your correspondent points out several inconvenient conditions as inseparable from the system of two eccentrics, in reply to which, with your permission, I beg to make the following remarks. I will notice these conditions one by one after the same order H. E. has pointed them out.

First. I do not clearly see how it is possible to give the lead *at all* either with or without a complication of levers unless the eccentric precedes the crank in its *action*. Even supposing the working the valve, when going forward, by the upper pin of the double lever to be inseparable from the system, it has in my opinion a peculiar advantage, in this respect, over the four eccentrics, the rods of which are kept in gear partly by their own weight, for instance. Suppose some derangement to take place in the reversing apparatus of an engine fitted with with the four eccentrics; the two suspended eccentric rods would fall upon the lever studs of the valve motion, and very probably cause a most serious crash. Now with the double ended eccentric rods the case would be rather different; their falling from the upper to the lower studs of the double levers would only reverse the action of steam upon the pistons, and as the engine-man has always the power to shut off the steam, he could *instantly* prevent the reverse motion of the engine.

Second. The centre of the double lever shaft may be situated above or below the line C, E, just as circumstances may require, but it is requisite to fix the eccentric so that it shall be exactly perpendicular to the centre of the shaft and crank axle, when the piston is at either end of the cylinder. I do not see any just reason why this should be considered as an inconvenience.

Third. I beg to state the amount of lead is *not* dependant upon the length of the eccentric rod, as H. E. has stated, but it depends upon the angle at which this rod works with the centre of the lever shaft and crank axle.

Fourth. It is possible to construct the valve motion so as to give the power of increasing or decreasing the amount of lead both ways, but as this would cause an additional number of parts, and consequently render the system more complex, I will admit of "the lead being determined must remain invariable."

With the four eccentrics, providing they are all independent of each other, that is, fixed on the shaft separately, you certainly have the advantage of varying the amount of lead; but the eccentrics are not always *independent* of each other, they are very frequently *cast all together*. In this latter case the lead, for both ways, is determined in the eccentrics, and of course remains *fixed*, therefore, you cannot increase it one way without diminishing it the other, this H. E. has pointed out to be the *most serious objection* to the two immoveable eccentrics. With the four independent eccentrics the lead may be varied correctly both ways it is true, still this is a rather particular point, and requires considerable time to effect the alteration accurately, consequently, I am informed, is very seldom resorted to. I have hitherto been totally unaware of what H. E. has stated in his eighth paragraph.

Another correspondent (An Apprentice in Glasgow,) remarks that "I have described the contrivance for working an engine with one eccentric as an invention of my own, although it has long been quite common in that country." I certainly have described it as my own, and I had every possible reason for doing so. I was not aware that it had ever been applied *successfully*, that is, exactly *correct in every point*. But I am aware, and well aware too, that engines, for winding purposes, have long been common in mining districts with one immoveable eccentric, and a double lever for reversing; and I have been informed that this contrivance has frequently been applied to engines for marine purposes, but in *both cases* has failed in point of correctness. This has been the consequence of not fixing the eccentric rods at the *proper angle*, &c.

Notwithstanding all that H. E. has said, he, together with the Apprentice, appears to be in favour of the two immoveable eccentrics.

I remain, Sir, your's, very respectfully,
J. C. Pearce.

Leeds, Feb. 8, 1841.

ON THE CONSTRUCTION OF IRON BRIDGES.

When we consider the superiority of iron bridges, says M. Polonceau, in his notice of the new plan of iron bridges invented by himself, and of which the bridge of Erdre (at Nantes) affords a good specimen, we are astonished that so few have been constructed in France, and even in England, where it is so much the custom to make use of iron, and where it is so plentiful. If these bridges are compared with stone bridges, it will be found that they are constructed with much less difficulty, and that they are considerably less expensive, and that when they have cast-iron roadways they are not inferior, if not superior, to them in durability. In fact, cast-iron is more durable and more strong than stone; it is better adapted to bridges with large arches, because the weight of an arch in iron being much less than that of an arch in stone of the same span, the destruction of the piles and abutments is less to be apprehended, and on this account can be constructed at less expense.

Compared with wooden bridges, bridges of cast iron cost about a half less than bridges of that kind which have abutments in stone; but their duration is indefinite, and the keeping wooden bridges in repair is attended with great expense, while the cost of repairing iron bridges is a mere trifle. The difference of expense between solid iron bridges and that of well executed suspension bridges is not so considerable as might be supposed.

In endeavouring to explain the causes which have prevented these kind of bridges from being more generally used, continues M. Polonceau, we discover three principal ones which have been unfavourable to their general adoption.

First—The great expense of iron, and the uncertainty in the casting of the larger pieces, before the year 1830.

Second—The great expense of the only two iron bridges constructed in France before that time. The cost of the *Pont des Arts* amounted to 900,000f., and that of Austerlitz to two millions and a half, not including the approaches.

Third—The accidents and repairs required by these two bridges.

Those works of art were constructed on two entirely opposite principles. In the bridge of Austerlitz the arches, and the triangular pieces above them which support the roadway, are composed of portions of the arcs in frame-work, and are attended with all the inconveniences consequent on this plan; and further, these frame-work pieces are small, much ornamented, and are of unequal thickness, and to this may partly be attributed the accidents which take place.

The plan of construction adopted in the *Pont des Arts*, which is composed of large arches connected together by pieces of iron, is more rational; but the principal arches are not sufficiently strong, and owing to the variations in the thickness of the castings, the metal contracts and expands unequally. In each of these bridges durability has been sacrificed to lightness and elegance, which occasions frequent fractures in the least durable parts.

Southwark Bridge, in London, one of the most remarkable of the kind, is composed of portions of arches, like the bridge of Austerlitz, but those are plain, and are not carved, although they are more than two metres high, and the method on which they are arranged is much superior to that adopted in the bridge of Austerlitz. The strength and entire preservation of the Southwark bridge is to be attributed entirely to the great quantity of iron used, which was procured at enormous expense, and amounted to more than fifteen millions of francs. It is probable that the great expense of this beautiful structure has prevented its being imitated.

The natural consequence of what has been stated is, that it is impossible to erect any more iron bridges in France, unless a new plan could be adopted of constructing them on more durable principles than those kind of bridges have ever been constructed, and at less expense than the English bridges. This double problem M. Polonceau has solved, by constructing, on an entirely new system of his own invention, the Carrousel bridge at Paris.* It is on this plan of making bridges, now well known by the name of Polonceau bridges, that the bridge of Erdre is also constructed.—*Echo du Monde Savant.*

* See drawings and description of this Bridge in the Journal, Vol II. page 79.

RAILWAY SIGNALS AND REGULATIONS.

We last month gave a copy of the resolutions passed at the railway conference at Birmingham; since then a full account of their proceedings has been published, with the code of signals and regulations proposed to be adopted on all railways throughout the United Kingdom, a copy of which we give in full.

RULES AND REGULATIONS, PROPOSED TO BE OBSERVED BY ENGINEMEN, GUARDS, POLICEMEN, AND OTHERS, ON ALL RAILWAYS.

Orders to Enginemen and Firemen.

I.—No locomotive steam engine, except in case of some extraordinary necessity, shall pass along the wrong line of road—that is to say, on the right hand line as it moves forward—but shall, in all cases, observe the same rule of the way as on the turnpike roads, by proceeding along the left-hand line. And every engineman and fireman shall keep a good look-out all the time the engine is in motion. And no person, except the proper engineman and fireman, shall be allowed to ride on any locomotive steam engine or tender without the special licence of the directors, or of the engineer or manager of the railway.

II.—In case of accident, if any engine shall be unavoidably obliged to pass on the wrong line of road, the engineman shall always send his assistant, or some other person, back beyond the nearest stopping place or shunt, before the engine moves backward, to warn any engine coming in the opposite direction; and if dark, the man who goes back in advance of a returning engine shall take a light, and make a signal, by waving the same UP and DOWN to any coming engine to stop; and the engineman of the engine moving on the wrong line shall make constant use of the steam-whistle, and must not move in the wrong direction further than to the nearest shunt, and being arrived there, shall proceed instantly to remove the engine off the wrong line of road.

III.—All engines travelling in the same direction, shall keep half a mile at least apart from each other; that is to say, the engine which follows shall not approach within half a mile of the engine which goes before.

IV.—No engineman shall, at any time or under any circumstances, leave his engine or train, or any part of his train, on the line of way, without placing a man in charge of the same, to cause the proper signals to be made to prevent other engines from running against them.

V.—Enginemen having charge of goods or luggage trains shall always exert themselves to keep out of the way of coach trains, by shunting, if necessary; and, if doubtful of getting out of the way of a coach-train, shall direct gatemen and plate-layers to make signal to coach trains that a luggage train is before them.

VI.—No engine, carriage, or wagon, or train of carriages or wagons, whether loaded or unloaded, shall (except only in case of absolute necessity, to prevent accident or collision) stop upon the line of any highway, so as to interrupt the passing along such highway or public road, whether the same be at or near to any of the stopping places on the railway or not.

VII.—No engine shall be allowed to propel before it a train of carriages or wagons, but shall in all cases draw the same after it, except when assisting up an inclined plane, or in case of any engine being disabled on the road, when the succeeding engine may propel the train *slowly* as far as the next shunt, or turn-out, at which place the said propelling engine shall take the lead.

VIII.—In the event of the road being obscured by steam or smoke, (owing to a burst tube, or from any other cause,) any engine or train coming up shall not immediately pass through the steam or smoke, but the engineman shall stop at a sufficient distance to prevent a collision, and shall ascertain that the way is clear and safe before attempting to proceed.

IX.—If a coach train be stopping to take up or set down passengers, on the road, or for any other cause, luggage trains are not allowed to pass it, while so stopping, on the opposite line; and if the engineman of a *coach train* sees another coach train stopping on the road, he must slacken speed as he approaches it, and blow his whistle, to give notice to passengers belonging to the stopping train, that another train is about to pass them.

X.—In going down any inclined plane, every engineman having charge of a luggage train, shall take care that he has full and competent control over the speed of his train, by pinning down, or causing to be pinned down, his wagon breaks, fewer or more, according to the size or weight of the train, whether there be a luggage break-man with the train or not. And in case of accident for want of this proper control over the speed, the engineman shall be held responsible. And the policemen at the top of the inclines shall, and are hereby charged to, assist in pinning down the breaks, when desired so to do by the engineman of the train.

Rules to be observed during a Fog, or in Thick Weather.

XI.—Whenever a coach train stops at any of the stations or places for taking up or setting down passengers, (during a fog, or in thick weather), the gateman or policeman of the station shall immediately run 400 yards behind the train, or so far as may be necessary to warn any coming engine, in order to prevent its running against the other; and all enginemen shall slacken speed in foggy weather, and proceed at a slow pace at an ample distance from, and as they approach, each of the stations and stopping places, in order that they may have the complete control of and be able to stop their engines and trains without risk of running against any train which may happen to be waiting at such station or stopping place. And in case any engine (whether with coaches or luggage waggons, or without) shall stop in foggy or thick weather in any part of the road where there shall be no plate-layer to render assistance, the fireman shall immediately run back 400 yards, or so far as may be necessary, to warn and stop any other engine coming in the same direction.

In foggy weather, enginemen are cautioned to make frequent use of their steam-whistle when they approach any station; also, whenever they are obliged to stop on the road, or when, from any cause, they are obliged to go slower than usual, in order to prevent accidents from trains which may be following on the same line.

Order to Gatemen and Policemen.

XII.—All policemen and gatemen are required, when a luggage train approaches their several stations, and before she comes up, to go on the line and inspect both sides of the train, to ascertain whether any of the loading (particularly bags of cotton or wool) have slipped so as to *overhang* the waggon more than when first loaded; and if such be the case, to make immediate signal for the *train to stop*, in order that the loading may be put right and fastened on again before the train proceeds.

N.B.—All enginemen, firemen, guards, policemen, gatemen and others to whom the foregoing rules may apply, are held responsible for their strict execution and observance; and they shall report to the directors, or to their immediate superintendent, any servant of the Company who shall refuse or neglect to comply with the regulations hereby ordered to be observed.

CODE OF SIGNALS RECOMMENDED TO BE OBSERVED ON ALL RAILWAYS.

By Night.—The *white* light, stationary, indicates that all is right, but if waved *up* and *down*, is a signal to stop; if waved *to* and *fro*, sideways, to proceed cautiously.

The *red* light, stationary, is a signal *always to stop;* if on a moving train, it is a caution to all following trains to keep the required distance.

By Day.—The *red* flag, or ball disc, is the signal always to stop.

The *blue* flag, or ball, is to stop second class coach trains or luggage trains, for the purposes of traffic.

The *black* flag is used by plate-layers, to indicate that the road is undergoing repair, and that trains must pass slowly.

It is to be understood, that any flag, or hat, or lamp, of whatever colour, waved up or down, is a signal to *stop.*

Regulations as to Signals.—1. Every train on the railway shall show a red bull's eye, or reflector lamp, on the last carriage or wagon; and the guards of the coach trains, the breaksman of the luggage trains, and the engineman of an empty engine, or, with a wagon train without a breaksman, shall see to and be held responsible for, the execution of this order; and if a coach, or truck, or horse-box, or wagon, be attached to or detached from a train on any part of the road, the guard, or breaksman, or engineman shall immediately change and replace the red bull's eye, or reflector lamp, so that the same may still be in the *rear* of the last carriage or wagon in the train, showing backward.

2.—Every engine tender must carry a lamp, so fixed as to admit of being turned round, exhibiting a *white* light forward, and a *red* light backward, in whichever direction the engine may be moving.

3.—Every gateman or policeman shall light his gate or station lamp at dusk, and shall have his hand lamp constantly trimmed and burning, and ready to give such signals as may be required.

4. If a coming engine or train be required to stop to take up passengers, a *blue* light must be shown in the gate-lamp; otherwise the common *white* light.

5.—If a train approaches when a previous train has passed through, only a few minutes before, the gateman shall signify this circumstance to the engineman by the waving of his hand-lamp *to* and *fro*, sideways, which means that caution is required; on which signal all enginemen are required to go slowly and keep a good look-out.

6.—But if a gateman, owing to some accident, or any extraordinary cause, wish to stop an engine which is approaching, he must show his *red* light, and must also wave his hand-lamp *up* and *down*, up to the height of his head, and then down to the ground, till the engine comes up; and all enginemen are required to stop at either of these signals being given; and a gateman must make this signal to an approaching engine, if a previous engine has passed through this gate only one or two minutes before.

N.B.—The *red* flag, or ball, must be used in the day, in the same manner as the *red* lamp by night.

Rockets or *blue* lights are extraordinary signals, and when an engineman sees them he must immediately stop to ascertain their cause.

Engine Whistle.—7. When *one long whistle* is given, it is a signal to gate keepers, policemen, and others in front, that an engine is coming, and this signal is to be used on approaching public roads, during a fog, or when a first class train approaches a station where a second class train is stopping, and generally as a caution when required, for persons on the line to keep out of the way.

But when an engineman wishes to make signal to the guards, or breaksmen *on the train*, that they are to put on their breaks and stop, he must give a *quick succession of whistles*, making an interrupted, tremulous, or vibrating sound; and all guards or breaksmen, whether with coach or luggage trains, hearing this signal, *must immediately* hold hard on the break or breaks under their charge, so as to stop the train *as quickly as possible*.

NEW INVENTIONS AND IMPROVEMENTS.

IMPROVEMENTS IN STEAM ENGINES.

Thomas William Parkins and Elisha Wylde, of Portland-street, Liverpool, Engineers, for an improved method of making and working locomotive and other steam engines. Enrolment-office, Jan. 12, 1841.

This improved method relates to the slide valve and throttle valves of steam engines, and consists in a novel mode of constructing them, so as to facilitate the action of the valves, to place them under more perfect control, and to afford a freer entrance to the steam cylinder under certain circumstances.

The first arrangement is for working the slide valve without the use of eccentrics, in order that it may open almost instantaneously at the time the engine is passing the centre. For this purpose a lever is fixed upon the cross-head working in a link connected to a second lever fixed on a shaft or weigh-bar across the engine, whereby a rocking motion is produced. On the other end of the weigh-bar a double lever is fixed, carrying two studs above and below the centre of the said shaft or weigh-bar, for the forked rod to work upon. One end of this rod is attached by a working joint to a fourth lever fixed on the weigh-bar, which gives motion to the slide valve at each succeeding return of the cross-head to the extremity of its stroke. The levers are so arranged that the slide valve is always kept wide open at the period of the engine passing the centre, instead of being shut, as is always the case when an eccentric is used, and by which means the full effect of the steam is employed up to the last moment.

Secondly, a new method of constructing the slide valve, being an improvement upon the old D slide valve, is described; the object being to get rid of almost the whole of the immense steam pressure which always presses upon slide valves of the present construction, and at the same time to give a free passage for the escape of the waste steam throughout the whole of the stroke. This slide valve consists of a hollow square ring of metal, working between two surface plates, the lower one being the side of the cylinder, the upper one provided with set screws or other suitable means of adjustment. The hollow ring beds upon the cylinder, and is furnished with a square metallic packing upon its upper surface, which, abutting against the adjusting plate, makes the slide valve perfectly steam tight. The slide valve is made long enough for the eduction passage to remain open while the steam way is closed, and *vice versa*.

Thirdly, the patentee describes a peculiar mode of constructing the regulator or throttle valve of steam engines, especially as applied to locomotive engines, so as to afford a ready and convenient means of admitting steam to either one of the cylinders only, or to both of the cylinders at the same time. The regulator or steam passage is in this case a flat surface, with passages through it at the distance of one end of the cylinder from the other, and so disposed that when the regulator's handle is inclined to the starboard, steam is admitted into the cylinder on the larboard side of the engine; on inclining the handle over to the larboard, the steam is also admitted to the starboard cylinder, but on placing the regulator handle in a vertical position, the throttle valve is closed, and the steam communication cut off from both cylinders.

A fourth improvement consists in certain additions to the machinery for working the slide valve, so as to cause the steam to work in the cylinder expansively, in order to economise fuel; for this purpose two slots are made in the top of the link in which the cross-head works, in which two bell-crank levers work on pivots; to the under side of the engine framing, a roller is fixed between the two levers, being a fulcrum to act against when they are alternately pressed down by the roller (attached to the lever on the cross-head), which works in the link passing over them; this causes the link to advance sufficiently to close the slide valve, or, in other words, to shut off the steam at the determined portion of the stroke.

Finally, an arrangement is exhibited for reversing the direction of the steam, so as to stop the engine and drag the wheels whenever circumstances render such a procedure necessary. In order to accomplish this movement, a handle is placed on one side of the foot plate, which is connected to a bell-crank lever, connected by a link to the tappet-rod. This handle is to be secured by a spring guard, and when in a vertical position the tappet-rod will be entirely out of gear; when it inclines forward, it will be in gear for going either forward or backward; and when it inclines backward, the tappet-rod will be lifted on to a stud on the third lever above the centre of the shaft connected with the link on the other side, which will stop the motion of the engine almost immediately, as the steam will be admitted into the cylinder before instead of behind the piston, which will drag the wheels and bring up the engine.

The claim is to 1. The construction of the slide valve, being a hollow ring through which the steam is either admitted or exhausted, and the means used for keeping the said slide valve steam tight.

2. The combination of the machinery for moving the valve, especially the construction of machinery for moving the said valve so as to work the steam expansively.

3. The construction of the regulator or throttle valve by which steam is admitted to either cylinder only, or to both cylinders at the same time.

4. The construction of machinery for moving the slide valve so as to cause the steam to enter the cylinder before instead of behind, and make it act against the piston.—*Mechanics' Magazine.*

TOOLS FOR BORING.

William Ash, of Sheffield, Manufacturer, for improvements in augers and tools for boring. Petty Bag Office, Dec. 24, 1840.

These improvements consist in the combination of cutters and guides with a shank or spindle. The cutters are rectangular pieces of steel somewhat resembling the cutting side of a centre-bit. The guides are helical pieces on the outside, of various sizes, the interior of which fits the shank or spindle. The spindle has a pointed screw at the end, the size of the thread varying according to the kind of wood to be operated upon; at some distance up, on the side of the spindle, there is a circular stop, there is also a square opening just above the worm, passing through the spindle. The helical guide, of the size required, is first put on the spindle, and a cutter inserted in the square aperture below it, where it is firmly fixed by driving in a wedge. If a larger or smaller hole is required, the wedge is struck out, when the cutter, &c. may be easily removed, and replaced with guides and cutters of the size required. Another form of guide is shown, consisting of a circular plate of metal, with a thimble in its centre, supported by two cross pieces from the outer edge. The first, or helical guide, however, is preferred, from its being longer, and also from its affording a channel for the ready escape of the chips, thereby clearing the hole as the cutter advances.

The claim is for the application of moveable cutters and guides to a shank or spindle, as described.—*Ibid.*

MACHINERY FOR CUTTING AND WORKING WOOD.

William Hickling Bennett, of Wharton-street, Bagnigge Wells Road, Gentleman, for improved machinery for cutting and working wood, Enrolment-office, Dec. 24, 1840.

The improvements comprehended in this patent are—Firstly, a new system of guides for boards while passing through the wood-cutting machines. The iron frame of the guides varies in shape in different machines; it forms a bed on which the guides traverse. The guides are formed of puppet-heads in pairs, one being fixed, the other moveable in order to hold and guide wood of different sizes. Moveable pieces slide over the inner vertical faces of the guides, and pressing down upon the upper surface of the wood it is thus held firm and steady.

Secondly, an improved mode of elevating and depressing the upper pair of rollers, when the wood is carried forward by their means. The axes of the upper rollers turn in blocks which slide up and down in grooves in the upright side frames of the machine. They are regulated by spur and bevel wheels, in conjunction with spiral springs, so that while the wood is firmly held, an elasticity is obtained by means of the springs, which allows any irregularities in the surface of wood to pass through the rollers.

Thirdly, an improved mode of admitting oil to the working parts, viz., the circular saws, shafts, spindles, &c., consisting of a cup with a tube at the bottom furnished with a stop cock, to be so adjusted as to allow any number of drops per minute to fall from the nipple into the channel leading to the bearings requiring lubrication.

Fourthly, an improved mode of sawing and dividing wood, so as to effect the planing at the same time; the arrangement being also applicable to veneer saws.

For this purpose, there are slots near the periphery of the circular saws, approaching as near to the edge as is consistent with due strength; in these slots side cutters are fixed, with their edges ground and set to the same angle as a plane iron. These cutters project slightly beyond the set of teeth of the saw; so that a shaving is continually taken off as the saw revolves. Or the edges of such slots in the saw plate may be turned up and used in lieu of detached cutters.

Fifthly, the application of the foregoing construction with two or more sets of circular cutters, so as to form two or more strips of plain or ornamental moulding. To accomplish this, two or more circular saws are mounted on one spindle between which, instead of washers, blocks are fixed, holding the cutters in the upper edges. These are circular and may be either plain or moulded, and they project sufficiently to perform the necessary operation as rapidly as the circular saws can rip the scantlings or boards into strips.

Sixthly, an improved mode of forming moulding and other cutters. These cutters may be of any required shape, and are attached to blocks, fixed on the saw spindle by grooves and feathers. They are made of thin steel plates screwed between two metal plates, which are worked down on each side so as to leave the steel edge projecting about $\frac{1}{16}$ of an inch.

Seventhly, a machine for preparing deals and baulks of timber for sawing. The wood to be operated upon is laid on a metal bed moved by a rack and pinion and slides on V pieces fixed to the floor. The apparatus for holding the timber is firmly secured to this bed; puppets are screwed to the sliding bed, their inner faces being made perfectly true. To these faces a cast-iron beam is attached vertically, so that it can be moved up and down, by nuts and screws, and serves to clip the upper part of the piece of timber.

The holding parts are capable of adjustment, so that timbers of any size may be held on different sides quite firmly, and brought up to the cutters by the traversing bed, for preparing a flat or square side thereto.

Eighthly, a machine for the same purpose, which may also be used for cutting mouldings or cornices and skirting-boards.

The wood in this case is secured to a traversing table and moved forward by a chain, rack and pinion, or other convenient means. Circular cutters are made to revolve above it, which strike the required pattern on the edge of the wood as it advances.

Ninthly, another machine for the same purpose, only in this case the machinery with the cutters approaches the wood instead of the wood approaching the cutters. This consists of a moveable bed traversing upon a fixed one; this bed carries the cutters with their driving wheels, &c. The wood is held upon a rising and falling table, while the machinery, cutters, &c. on the traversing bed are made to approach and perform the required operations on its surface and edges.—*Ibid.*

MACHINERY FOR PRODUCING PLAIN OR MOULDED SURFACES ON WOOD.

James Hodgson, of Liverpool, Engineer, for a new mode of combining and applying machinery for the purpose of cutting and planing wood, so as to produce plain or moulded surfaces. Enrolment-office, Feb. 3, 1841.

This invention consists in a mode of combining and applying machinery, whereby the patentee is enabled to employ a rotary spiral cutter for cutting and planing wood, so as to produce either plain or moulded surfaces. The machinery consists of a strong cast-iron frame, of any required dimensions, planed perfectly true on its upper edges, the feet or standards being bolted down to the flooring so as to give great firmness and stability. A cast iron table, also planed perfectly true, slides smoothly and equally upon the bed; this table is fitted with a cover or plate of wood on its upper surface, for the convenience of affixing thereto the wood to be operated upon by the machine.

Nearly in the middle of the bed there rises an upright frame or slide, in which the revolving spiral cutter is supported, and raised or lowered by a screw. The spiral cutter consists of a twisted bar of steel, or of iron and steel combined, the cutting edge passing from one end to the other in a spiral direction around the axis of its motion. This cutter is driven at a great speed, and revolves transversely to the grain of the wood. Such a cutter is adapted for the production of plain surfaces only; if mouldings are to be produced, the cutter must be worked out to the pattern intended to be given to the moulding. One mode of effecting this is stated to be by making a steel tool of the pattern required, which is placed beneath the spiral cutter while in rapid motion and gently raised as the cutter becomes indented. The edges of the pattern thus produced, are then filled up to an angle and sharpened, so as to make a clean cut in the wood moulding. The motion is supplied from a steam engine or other prime mover to a fast or loose pulley, from whence a series of wheels and bands communicate the necessary high velocity to the spiral cutter. The table on which the wood is fixed to be cut slides backward and forward upon the bed; a rack placed on its under side is acted upon by a pinion, driven by suitable traversing gear, and carried forward to the cutter. The backward movement is accomplished by a small handle on the axis of the pinion.

The claim is for the mode described, of combining and applying machinery so as to employ a spiral rotory cutter for cutting and planing wood so as to produce plain or moulded surfaces.—*Ibid.*

IMPROVEMENTS IN ROOFING AND SLATING BUILDINGS.

James Taaffe, of Shaw-street, Dublin, Slater and Builder, for improvements in roofing and slating houses and other buildings. Enrolment-office, Feb. 1, 1841.

These improvements consist of a novel mode of roofing and slating houses and other buildings, whereby much of the overlapping of the slates will be avoided, and roofs will be more advantageously formed and constructed with a much smaller quantity of timber and slates than at present used. And a roof formed according to the tenor of this patent, will, it is said, be much superior to that which could have been produced by a larger quantity of timber and slate applied as hitherto practised. In the first place, the rafters have a groove ploughed or otherwise made in their upper surface which is to be lined with lead, zinc, or other suitable metal to form water channels or courses. Two other modes of forming these water courses are shown: in the one case the rafter is divided into two and an angular metal gutter placed between; the other is formed by nailing two projecting strips of wood along the sides of the rafter, which form the sides of the channel. The rafters being furnished with proper water channels in some of these, or other convenient ways, slates are taken of such a width as to reach exactly from the centre of one water course to the centre of the next, so that the side joinings of each series of slate fall exactly over the centre of the water channels, by which means any water that may pass through between them is carried off into proper gutters. The first or lowest row of slates are screwed to the rafters by four copper screws, one in each corner, but in all the other rows, two screws, at the upper corners, only are used. Nails may be used instead of screws for fastening the slates to the roof, but the latter are preferred.

Where the slates overlap each other they are held together by clamps of this form, ⌶, made of copper or zinc. A notch is cut in the sides of the two upper slates, and a space cleared away in the two lower ones to admit the stem of the clamp. On the under side of the slates where they overlap, two throats or grooves are cut to prevent the water from running along underneath and so getting beyond the water channels.—*Ibid.*

COKE OVENS.

John Cox, of Ironmonger-lane, civil engineer, for improvements in the construction of ovens for the manufacture of coke, and other purposes. Jan. 19.—The oven is constructed of any convenient form, and of suitable materials. The best Stourbridge fire-bricks, with the joints closed by the same clay of which the fire-bricks have been made, is preferred. The roof of the oven is to be made very thin, and a broad flat shallow flue formed over it. The oven is charged in the usual manner, and the door closed, and as the gaseous products arise they are conveyed through proper small apertures into the flue above, where they are supplied with a sufficient quantity of atmospheric air to support combustion. They are consumed in the flue, and the heat transmitted downwards, for the purpose of promoting the process of coking through the roof of the oven. In some cases only part of the distilled products is consumed for the purpose of coking, and the remainder carried away in any convenient manner for any other purpose for which it may be required. In other cases the atmospheric air is admitted into the chamber with the coal, and thereby the products are consumed together with the coal. Sometimes retorts or other small vessels to be heated are set in the flue above the roof of the oven, and the products consumed as at first described.—The inventor does not claim the mode of consuming the distilled products in the same chamber as the coal; nor the application of flues to the bottom, sides, or ends of the oven; but he claims—First, The creation of heat by the admission of atmospheric air to the distilled products in or after they have left the oven, and the consequent combustion of the said products in or after they have left the oven.—Second, The same, whether the air be admitted at the top, bottom, sides, or ends of the oven.—Third, The same, whether the heat be employed for the process of coking only, or for manufacturing or other purposes as well.—Fourth, The promoting the process of coking by the application of a flue or flues over the top of the oven; whatever be the form or construction thereof.—*Inventors' Advocate.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

KING'S COLLEGE.

MR. HOSKING'S LECTURE.

We are glad to see that the Class of Engineering and Architecture is being carried on under such good auspices; our readers will see, by the following sketch, the course that Mr. Hosking proposes to adopt in the important department of instruction which falls under his direction. In expressing our approbation of the general views propounded by Mr. Hosking, we have to thank him and his colleagues at the College for their courtesy to us on this and so many other occasions.

After some introductory observations Mr. Hosking proceeded as follows:

"The printed paper already in your hands gives a general statement of the matters to which I shall have to direct the attention of the student, and I believe that every man who has had to learn these things for himself will readily admit that any instruction in them, however imperfect it may be, may become of the greatest practical value, by supplying, as a ground work for professional study, what has had, but too often, to be learnt in practice, and what, oftener still, is never learnt at all.

"We cannot hope here to make young men carpenters or masons, but we hope to make them better qualified to compose, describe, estimate and direct works of carpentry and masonry than they can be without such assistance as that we offer them. In becoming proficient as a carpenter, a mason, or a smith, a young man is apt to overlook the importance of other handicrafts in favour of that in which he has acquired confidence,—but a sound, and indeed a somewhat extensive practical knowledge of the modes of operating in all the leading crafts, of which the three I have mentioned, together with the bricklayer's craft, are the most prominent, is essential to the civil engineer, who only exists independently of the architect on the one hand, and of the practical machinist on the other, through his presumed superior practical skill in applying the operations of the carpenter, mason, bricklayer and smith, in connection with those of the navigator or earthworker and miner." The early life and experience of the late Mr. Telford are next referred to, with an account of his occupation in youth, and of his estimate of the value of such occupation to the intending engineer. Mr. Hosking then remarks:

"Such was the early education, and such were the matured opinions of the man who has left hardly a corner of our island without some important work to record his name.". . . . . " But Mr. Telford goes on, from the observations I have already quoted, to state thereupon his opinions and practice with regard to the education of the civil engineer: 'My readers,' he says, 'may *not* dissent from these observations, but few of them, unless practical men, will feel their full force. Youths of respectability and competent education, who contemplate civil engineering as a profession, are seldom aware how far they ought to descend in order to found the basis of future elevation. It has happened to me more than once, when taking opportunities of being useful to a young man of merit, that I have experienced opposition in taking him from his books and drawings, and placing a mallet and chisel, or a trowel in his hands, till, rendered confident by the solid knowledge which only experience can bestow, he was qualified to insist on the due performance of workmanship, and to judge of merit in the lower as well as the higher departments of a profession in which no kind or degree of practical knowledge is superfluous. *For this reason I ever congratulate myself upon the circumstances which compelled me to begin by working with my own hands.*'

" You will find indeed that not Telford alone, but that most of the men who responded to the demand that arose in the middle of the last century, for professional aid in the formation and construction of that class of works now distinguished as works of civil engineering, in default of skill and capacity on the part of the architects of the day, were men whose early education was that of the workshop;—they were *masons, miners*, and *millwrights*. Whilst the practical knowledge of Telford and Rennie—the mason and the millwright—exists in its effects upon those who had the advantage of working with and under those eminent hydraulic architects, the practice of civil engineering as at present constituted will continue,—but those who seek to engage in and follow it must qualify themselves by direct application to the sources from which it sprung, and upon which alone it can rest a continued existence. The man of science may be formed independently of the workshop—but it is through the workshop alone that the man of science can become what the men I have enumerated were; he may possess himself, in the office, and in the service as an assistant, of the established practitioner of the routine of business,—of the habit of using technical terms,—of repeating working and other drawings, and of using set phrases and forms in the composition of a specification;—he may learn to estimate and to describe the items of an estimate as they are usually described, and to attach prices to the items according to the established usage;—and having made these acquisitions he may consider himself fitted to practice as a civil engineer. He will feel himself competent to investigate any question that can arise in practice when the *data* are supplied.—but he will find that questions continually arise upon which no data are to be obtained; he will readily undertake to lay out and design any class of work within the range of engineering practice, but he will learn from the contractors as the work proceeds, that this cannot be done as he may appear to have intended,—that that will not do in this particular case, that such and such things are unnecessary, and such others essential, and when the works are completed he will have the mortification of finding that the variations made, and the alterations and additions effected have made his contract a dead letter. . . . . There are other cases, however, and they are already too frequent, in which conscious incompetence determines to be on the safe side, be the cost what it may, and works are overloaded with materials that they may be strong enough;—and thus again the employer is defrauded, for fraud it is if a man undertake a duty which he is not thoroughly qualified to perform."

Mr. Hosking then proceeded nearly as follows, giving an etymology of the designation of engineer, which has the appearance of novelty, and entering into details which we have not space to include in our mere abstract:—

" It may not be devoid of interest, and it may help to give a distinct perception of what the practice of civil engineering includes, if I trace the circumstances out of which it grew. Many of the works and operations now included in the practice of the civil engineer are of late origin themselves, and a large proportion of them were formerly within the practice of architecture, and was known, when distinguished at all, as hydraulic architecture. Modern fortifications, or fortifications having reference to ordnance, consist in a great degree of earthworks, and through the practice of forming them the different corps of military engineers became skilful in the disposition and working of earth,—in draining for the exclusion, and in forming conduits and sluices for the admission of water. As the advance of modern civilization required operations similar to those practised by the military engineers for protecting lands from rivers, and from the sea, by embankments,—for draining low lands,—for supplying towns, and for feeding canals with water, the peculiar designation of the military engineer and operator was adopted by the civil practitioner, who thus became what is known as the civil engineer. Throughout the continent of Europe the services of the architect had been still in requisition in aid of the military engineer, in directing the constructions for which he had occasion, and we thus find some of the finest works of many of the Italian architects from the 13th and 14th centuries down to the present time, on the gates of fortified places. In England, however, almost ever since the introduction of gunpowder, the fortification of towns and cities, fortunately, has not been necessary, and the British architect has had therefore no practice in connection with the military engineer. Hence, the almost total deficiency of architects in this country in hydraulic constructions, so that when a demand arose for works which imposed such constructions in connection with earthwork formations, the millwrights and masons, who had built the flood-gates and sluices with their wing and head walls, and had learnt to direct the formation of the earthworks from the Dutch embankers and drainers, were called upon to undertake them, and thus the hydraulic architect is found in conjunction with the formator or embanker and drainer, who brought to the profession thus compounded the designation of civil engineer.

" The practice of civil engineering and architecture is, therefore, strictly, the complete practice of architecture in its most extended sense; that of the former may be said to include formations and constructions influenced by, in connection with, or affected by, that powerful agent—water,—whilst, the separate practice of architecture is generally restricted to constructions not so exposed, and to constructions susceptible of, and subject to decoration. The architect who builds sewers and drains,—and it is within the practice of all architects to do so,—is in so far a civil engineer,—whilst the engineer who builds a bridge, or a viaduct, is in so far an architect, for although, according to the general definition that I have given, the founding of piers and abutments to a bridge over a river, or other water, would fall within the province of the engineer, the main constructions of a bridge, especially when of masonry, are within that of the architect."

" Roads as now made, and railways, are late additions to the practice of the civil engineer. Roads brought bridges with them, and railways have brought many other varieties of construction that can hardly be called hydraulic, for although their frequent connection with earthwork exposes them for the most part to the action of water, they are generally so situated as to demand the architectural dispositions which may be classed under the head of decoration. To be an accomplished civil engineer a man must, therefore, be a good architect in the ordinary acceptation of that term, as well as skilled in the sciences and arts of construction, far above what architects commonly are. Together with formations and hydraulic constructions the practice of civil engineering includes the application of machinery in the aid of commerce and of the useful arts. Hence, and because of the name applied to some of his productions, the manufacturer of engines and machinery, the mere machinist has been called an engineer. A machinist may certainly become a civil engineer, but the power of making a locomotive engine does not seem to form a better qualification for railway engineering, than that of carriage building does to constitute the builder an efficient roadmaker;—it is not the cannon-founder who is entrusted with the construction of fortified places and field works, but the engineer officer whose education and practice have fitted him for this more important service."

" In promising information and instruction that will be useful to you in the pursuit of your professions respectively, I must beg to be understood not to promise to qualify you here to practice as architects or as civil engineers. We offer you information whereby you may become qualified to avail yourselves more effectually of the practice of the engineer's or architect's office, and thereby to become *better* architects and *better* engineers, to your own confidence, comfort, and advantage, and for the advantage of society to whom your services will be hereafter offered, than you would have been without such instructions and information as we offer. The medical student comes here versed in pharmacy, and in the simpler surgical operations, and he finds his field of study and practice complete between the lecture and dissecting rooms of the college, and the wards and the operating theatre of the hospital, but to you, who come to us unskilled in carpentry and masonry, the pharmacy and surgery of your professions—we have the deficiency to supply, as well as to teach the science which those humbler arts aid you in applying, but *your* hospital must be walked in mud boots, and your operating theatre found on the stage of the carpenter, and on the scaffold of the mason and bricklayer. The young sailor may and should learn navigation on shore, and how to rig a ship and to reef and steer in harbour, but he must go to sea to become a sailor,—and the young architect or engineer, may and should, in like manner, acquire the theory, and learn, as far as may be, the practical arts of his intended profession, in a preliminary education, but he must place himself with the active practioner through whom he may have facilities for seeing works in progress, and opportunities of assisting to forward them, together with the means of acquiring the technicalities of practice, to become an efficient practitioner of architecture and engineering himself.

But why, I may be asked, if the practice of an office and the observation of actual works is essential after you have expended time and money here, why not go from school or college at once to a practical office? I answer, that without such preliminary education in science and the arts as that offered you here, the practice of an office will be in a great degree lost upon you; you may learn by rote but you will not know the meaning of the words—you may have opportunities of seeing works, but "seeing you will not see, and hearing you will not understand;" the characters may be clear, and the meaning of the words obvious, but to you they will be unknown, and therefore unintelligible.

I would say, then, acquire superiority over the merely practical man—the rule of thumb engineer by the attainment of sound scientific knowledge, in addition to the mere practical skill with which he tenders his services;—but do not depend upon scientific knowledge alone, if you propose to become civil engineers, and hope to gain your bread by the practice of civil engineering as a profession, for it may be truly said, paraphrasing the beautiful language of an inspired writer, you may have all learning and all science, but if you want this practical knowledge of which I speak, you will be but "as sounding brass or a tinkling cymbal."

SCHOOL OF DESIGN, LEICESTER SQUARE.

On Monday the 15th ult., a lecture on the application of perspective, being part of a course, was delivered by George Foggo, Esq., at the School of the Society for Promoting Practical Design, Saville House, Leicester Square, before a numerous and respectable audience of members of the society, artists, students, &c.

The lecturer commenced by urging the necessity of a knowledge of perspective in ornamental design; observing that however the students in that class might be inclined to undervalue such an acquirement, they could not nor did not make a drawing without availing themselves of it. So accustomed are we to see objects in perspective, that we are perpetually putting objects in perspective without being aware of it. The child newly born is destitute of this knowledge, but we cannot pass through life without acquiring it—we must perforce obtain a knowledge of the distance of objects, their relative positions, their size, their colour. There is not a human being who does not learn this—not an animal—we could not go through life without it. Whether in historical composition, or whether in architectural design, we are obliged to have recourse to perspective. The architect, after making his design, may think he has nothing to do with this science, but if he do not attend to it, he will soon find himself in serious difficulties. Suppose, for instance, he has designed a frieze; although it may look very well upon paper, yet, when it comes to be placed high up, and lighted in a particular way, he may find the effect very different from what he intended. From want of knowledge of this kind, lamentable errors occur; in buildings recently erected, ornaments are lighted with windows in such a way as to lose their effects; a delicate scroll is placed at such a distance as not to be seen, and bold ornaments brought too near. I am anxious, said the lecturer, that in drawing ornament we should not draw it as if it were a mere dead inanimate object, but should remember that taste is required for designing pure ornament. This may not suit those who are contented with copying, and think that they have done enough when they have reproduced a design from the French, or the German, or the Italian, or the Greek; but it is the right course—copying we always find limited, nature ever varying. We have heard much lately about copyright of all kinds, but I think a great deal more has been said than has been necessary; I am by no means disposed to admit that copyright can be derived from the mere act of copying the design of another, whether that design be French or Greek, one year old or a thousand. Copyright should have no right for merely copying others, but for original adaptations of natural objects. Composition requires originality and power of mind, without which the name is idle. The architect has irregular materials to bring into regular proportions; the designer of artistical compositions has the opposite course, to take fixed objects, and to place them in every allowable variety of attitude that is to be found in nature. Some imagine that great diversity of power is required for these two objects, that it takes very little power to make an architectural design, and much to produce a picture. I am not inclined, however, to allow this. Want of reference to nature is, in my opinion, the principal defect of our architects, the result of which is the greatest inconsistency. Thus, if we want a church, the architect will, without regard to propriety, take a Greek temple for his model, and so in an edifice where no sacrifice is allowed, devoted to a religion by which it is abolished, we shall find the sacrificial ornaments of another creed. If we are to have a theatre, the same temple is referred to, and then we get the sacrificial emblems again. There is no thought of propriety, though a building should be appropriate in its character to the object to which it is devoted, and mark the circumstances which have influenced its erection.

The architect having to do principally with straight lines in composition, has of necessity much difficulty to contend with, but he has other and greater difficulties; the want of having men of taste to judge of his productions causes inactivity on the part of the architect, and the result is that he contents himself with making a flaming copy from some antique building of reputation, which pleases the committee because it saves them the trouble of judging. His rival, with less knowledge of the world, labours hard to produce a good plan and an original elevation; his plan is never looked at, because it is not understood, and his elevation being placed by the side of those of his competitors, is outstared by them, and so he is discarded. By and bye the favoured design is carried into execution, and then, to the general disappointment, it is quite inapplicable. (The lecturer here proceeded to sketch the ground plan of a building, and show the modifications which would be required in the external effect by different arrangements of the interior.) When an architect has got over the impediments thrown in his way by the ground plan, he will, without a knowledge of perspective, find himself in serious difficulties in making his elevation. There will be a want of important parts, broken lines, intricacies in the external arrangements, so that the eye can never repose satisfactorily. Still a good plan is a great thing, and it is of much importance that the public should know what plans are, for every one may now be on a committee some day, and it is very essential that this point should be understood. The elevation may mislead, while the plan is the first thing, and when we have provided for the useful, we can afterwards see what sort of a fine frontage can be applied. Some of the cabinet-makers and upholsterers studying here must very frequently be applied to with regard to furniture, when they first send in a drawing of what is imperatively necessary, and then do what they can to ornament it afterwards. Sometimes, however, the contrary occurs; a pretty drawing is made, and when the article comes to be put up, it is found clumsy and useless. Nor do I hold that it requires much less talent to design furniture properly than to design a building—and, indeed, in many of our recently erected club-houses, the architects have themselves designed the furniture, plate, &c. Unfortunately, however, architects have little studied this department, and if they attempt it, there is a baldness in their works far from pleasing.

Architects have not often, more particularly in crowded cities, the choice of situation, but still it is in their own power to do something more than they do. There was, for instance, no necessity in Pall Mall to swamp the Travellers' Club by rearing next to it the Reform; had this been done by others, Barry would most probably have been offended, but people are not so offended at their own deeds as at those of their neighbours. Here, however, the example is given, and so, perhaps, some day we may have another larger, and the Reform Club itself overshadowed. The back of the Traveller's Club is not the less admirable, and it is much to be regretted that the architect had not combined the two buildings in one design. It is, in fact, a duty of architects to avail themselves of the position in which their building is to be placed; if, for instance, the space were next to a church, then, by making the new buildings, though not uniform, yet in some degree, correspond with those on the other side, the church might be brought into the composition, and so a better effect produced. Regular composition in architecture requires a centre and two wings; so if we see a bridge with four arches, the effect is unpleasant, though this is sometimes avoided by making the piers more prominent, but this again leads to another impropriety. The bridge, to be effective, must have three or five arches. The building, too, requires good thick flanks; this Wilkins forgot, and thus, in the National Gallery, we have the flanks getting thinner and thinner till they come to almost nothing. Solidity of effect is a thing imperative—the human mind requires bulk—it does not consider surface sufficient; if we see a surface, we like to know what is behind it, and particularly with regard to stone, for we always imagine the other front must be something similar. I may be reminded that, in the Gothic, there are exceptions and most beautiful ones, but these are exceptions only as between the uninstructed and the instructed—the instructed will see where strength is, and so be better satisfied with the effect produced. It is our duty to make our building as vast as possible with the materials we possess; if we do something great with small materials, money is saved; if great materials are frittered away in petty details, we have spent a vast deal to produce a little effect. It may be thought much better not done at all, unless the effect be produced at little expense. Two instances have been greatly extolled by our travellers; St. Peter's, at Rome, say they, is so vast and so beautifully proportioned, that we do not perceive its grandeur, and it is only when we come to examine some of the parts, that at last we are convinced. Another instance is the column in the Place Vendôme, at Paris, which is made after a barbarous Roman model—a column in Grecian proportion, is covered with a thick coat of bronze, and made gouty, just like the Duke of York's column in the Park. If the Napoleon column appears 80 feet high instead of 150, it certainly appears to me much better to have spent *half* the money to have produced a column which should have appeared 150 feet high. It is travellers only who see things of this kind, who stand openmouthed with astonishment that much money should be thrown away to produce nothing.

Architects very frequently complain of want of money, but with injustice, for it is by no means the amount of money, nor the vastness of the material at their disposal, on which the affair depends, particularly if money be exhausted on a number of small parts. No error is greater than to divide a thing into a number of small parts; if we want to know the effect, let us go into a mountainous country, and we shall go on from one mountain to another, and always find the object in the distance of the same comparative smallness. We see the distant peak with clouds lying about the sides, dividing it, and some covering it, some lying in streaks across it, but it does not appear high. We get to the top of another mountain, but a deep valley lies between, and it still does not appear high; we climb from crag to crag, and when we have got to the top we have an unbounded view, but we do not appreciate the immensity of the elevation, we feel rather delight than surprise. Had we seen a precipice, instead of 15 or 20,000, a thousand feet high, the effect would have been different. Many instances might be mentioned, but there is one place in the United States where the view is so terrific, that no courage can encounter it twice. Persons who wish to see this place go provided with guides, and secured with cords, and after looking down become senseless, and when asked always refuse to try it again. So different is it to see a simple elevation, or to see a thing frittered away bit by bit. This is not without its lesson in architecture; the Gothic architects knew it and profited by it. We see it if we look at the Gothic spires and towers with their tops wreathed with ornament; such compositions show that our ancestors understood this effect perfectly. Let us sketch a tower: we have here a great height, but in proportion to the bulk is the apparent elevation reduced; to remedy this, we must do as Barry is going to do at the New Houses of Parliament, we place simple turrets at the corners, sometimes of unequal size to produce picturesque effect. Looking up, the eye runs along this narrow line, and appreciates the full height of the object, at the same time that the bulk is also felt by this combination of parts. The composition of Gothic buildings requires great consideration, both of perspective and composition, as well as of appropriateness of character. If we construct a residence for a clergyman, we must make it comfortable, but at the same time we must give it a certain clerical character; but if we make a house for a country squire, we must not have anything clerical at all. In the Gothic cathedral immense length was required to provide for numerous processions with music, when the effect produced by them is overcoming. Great elevation was also necessary. We always see, therefore, in such buildings, one part of great length, and as the screen was not originally placed where it now is, but at the entrance, the view was surprising, for while we had figures six feet high close to us, in the distance they were reduced to insignificance. If we look at the means adopted to produce elevation, we shall see that, however numerous the divisions of the columns were to provide the strength required, the architects always took care to have some small fillets, which, being continuous from the bottom to the top, and there vanishing into nothing, give the mind a conception of vast and unlimited height. The contemplation of a cathedral of this kind appears, perhaps, much more elevated, and has a greater effect in raising the imagination than even a mountain itself.

I know nothing in architecture which contains more composition than Gothic architecture—the Greek temple of vast proportions perched on an isolated rock is simple and majestic—but the Gothic cathedral contains an interminable variety of applications from nature. Having said enough on composition in architecture, I may say that it is of no trifling importance to the historical or landscape painter—both will find excellent studies in Gothic architecture. In the combinations of the architect and the artist there is something more required than mere arrangement of parts, for though the Greek architect is limited to such as are symmetrical, the Gothic is not so strictly limited, and the historical painter is called upon for no symmetry at all, yet composition, to have a lasting effect, must operate on the mind, as much as on the eye. We therefore require a combination of poetical feeling with symmetrical arrangement, for to the architect fine feeling belongs as much as to the artist, and although an architect may not have it in his power to make a cathedral, yet he can show much of the same qualifications in a small building, in furniture and hangings, or in plate for a dining room. Plate is generally ordered at the silversmiths to be made after the pattern of that of Mr. So and So, who had it presented to him for services in the East Indies, but as Mrs. So and So, who has never been in India, must have her plate like that of the other individual, it may be made as similar as possible in shape, and yet far from it in detail, and analogous to the condition of the lady. A case in point occurred to me. I was asked to design a monument for a person who was of a very peculiar character, of good circumstances, had been in trade, and led a very even samely life. The deceased having a relation who had died at the head of his regiment, a monument was desired for him like his cousin's. Here was the contrast, a quiet merchant and a dashing colonel, however I did what I could, and I do hope the thing will not be found fault with. If we have a piece of plate to design, we need not attend most to the weight of the material, but with lighter materials we may endeavour to give an appearance of quantity, making the ornaments bold, and cutting away metal and material in different places—although, by the by, persons do inquire into the weight of metal. I have known this to be the case with Committees of the House of Commons, where silver has been preferred to bronze, because it would make a difference of 150*l.* in the value of the material, though the bronze would have cost more in the end, as the cost of the chasing was great. There are several things stand much in the way of good composition—want of a fair protection for copyright, and want of judgment in the public. In the many competitions which are advertised every day, the paltry premium offered for the design may be a hundred pounds, while the profit on the work to be executed may perhaps be thousands. There is a third difficulty, and that is want of power in artists, from the want of fair competition, producing deficiency of high intellect, for those who have the power know better than to exert it on such occasions, they can trust to other ways for making money.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Feb. 8.—Edward Blore, V.P. in the Chair.

Messrs. G. A. Burn and J. J. Cole were elected as Associates.

Among the donations was a copy of Mr. Hay's elegant work entitled Illustrations of Cairo, presented by Mr. Greenough, and Mr. Scoles exhibited an interesting drawing by the late Mr. Bondini of the Cathedral of St. Peter's at Rome, and St. Paul's, London.

The construction of the stone arch, commonly called the stone beam, which exists between the towers of Lincoln Cathedral, having been discussed at a previous meeting of the Institute without any satisfactory results, from the paucity of data which existed in regard to this curious work of science, Mr. Nicholson, Fellow of the Institute, and resident architect at Lincoln, forwarded the following particulars. The arch is at a height of 80 feet from the pavement, immediately over the junction of the vaulting between the towers and the vaulting of the nave; its abutments are thus formed by the eastern walls of the two towers. The arch consists of 23 stones of unequal lengths; the width of the extrados is barely 1 ft. 9¾ in., the thickness of the arch is uniform throughout, 11 inches. The span measured horizontally is 27 ft. 11 in. between its *apparent* abutments, but the arch probably penetrates some more recent casing of the tower walls, so that probably the *actual* horizontal span equals 30 ft. The southern abutment is 12½ inches higher than the northern. This arch has hitherto been considered the segment of an arch; but the observations of Mr. Nicholson led him to the conclusion, that it is a pointed one, each half arch being struck with radii of different lengths, an inequality arising probably from unequal settlement. It is constructed of stone from the Lincoln quarries, the exposed surfaces being wrought with the toothed chisel in a careless manner. The joints are ill formed, and have a mass of mortar full half an inch thick within them. The arch vibrates perceptibly, and Mr. Nicholson is of opinion that the practice of visitors jumping upon it in order to produce this vibration, may eventually lead to very lamentable results. Mr. Papworth suggested that very probably the arch was constructed by the masons at the time to serve as a fixed mark, by which to test the accuracy of the vaulting of the nave, particularly in the groining stages. But Mr. Nicholson considered this ingenious hypothesis hardly admissible, as the four walls themselves afforded a solid datum by which to control the several levels of the vaultings.

Mr. Poynter read some admirable practical observations on the construction of observatories, with which we hope to furnish our readers at full length in some early number.

Feb. 22.—J. Kay, V. P. in the Chair.

Mr. G. Godwin was admitted as Fellow, and Messrs. Wood and Clarke were elected as Associates.

A volume of exquisite drawings by S. Burchell, Esq., of the details of Prior Birde's chantry in Bath Abbey, and ten guineas from T. L. Donaldson, Esq., secretary for foreign correspondence, were announced among the donations, and two numbers of a very well executed German work on Gothic architecture, now publishing at Nuremburg, were presented by Messrs. Black & Armstrong, booksellers, of London. This publication is remarkable for the judgment with which the subjects are selected, and the tasteful effect with which they are engraved.

A letter was read from M. Vaudoyer, corresponding member, communicating various particulars connected with architecture of recent occurrence at Paris, particularly in regard to Marochetti's monument to Napoleon, which consists of an enormous sphere on a square base, surmounted by an equestrian statue of the emperor with his frock coat and little hat. The style of the monument, and the employment of a foreigner on such a work, has excited much displeasure among the artists of Paris. M. Vaudoyer described a new species of competition, which took place in the time of Louis XVI., who was anxious to complete, in a becoming manner, the Palace of Versailles, then unfinished. Upon the recommendation of Monsieur Le Comte d'Aigmillers, five of the most celebrated architects of the period were introduced to the king, who explained to them his views and wishes, and called upon them to assist him by their talents in rendering the Palace of Versailles worthy the nation. He assigned to each of them 12,000 francs as a complimentary sum, and 5000 francs to cover expences, and gave them 8 months to prepare their designs. The intention was, when Messrs. Chalgrin, Heurtier, Antoine, Peyre Jun. and Paris, the architects chosen, had completed their designs to have them exhibited to the public, and then examined by a jury consisting of the candidates themselves and four other architects. This committee were to make individual reports on each, and a general report on the whole, and to select the two best for recommendation to the King, who was to be at liberty to choose any parts of the other designs, so as if expedient to form a new one composed of the chief beauties in the whole number, and which was to be carried into execution by one or both of the two selected by the jury. The designs were made and paid for, but never exhibited; for the storms of the revolutionary period began to cloud the horizon of the arts, and the scheme, so admirably projected, had no positive results. But M. Peyre published his, in his volume of designs, 1818.

Mr. Scoles, fellow, read an analysis of Col. Howard Vyse's splendid work *on the Pyramids of Egypt.* The great pyramid covers rather more than 13 acres, each side of the square being 764 ft., and the height is 480 ft. 9 in. It is generally supposed that the area of Lincoln's Inn Fields equals that of the Great Pyramid. But it appears that one side of that square between the houses, being 831 ft. and the other 625 ft. 6 in., its area is less than that of the Great Pyramid by about 64,000 square feet. The height of St. Paul's is 365 ft. or 115 ft. 9 in. less than the Egyptian building. Mr. Scoles then minutely described the mode of construction, the arrangement of the chambers and galleries, the objects found, and the chronological history of the erection and events connected with these huge wonders of antique art, tracing it down to the discoveries of the gallant author, and for which we must refer the reader to the work itself. Mr. Perring, a civil engineer, took the dimensions of these edifices, and Mr. Arrundale had the management of the volume, and the preparation of the drawings confided to him by the munificent author. Mr Scoles' description, which was rendered doubly valuable from his own personal examination of these monuments, was listened to with much attention, and gave rise to some curious remarks by Mr. Hamilton and other members. For our part, we cannot help imagining that there still remain unexplored chambers in these masses of construction, and that discoveries may still repay the patient investigation of future enterprising travellers.

ROYAL INSTITUTE OF ARCHITECTS OF IRELAND.

ADDRESS TO SIR RICHARD MORRISON.

In a recent number of the *Mail* we noticed with pride and satisfaction the honour so deservedly conferred on our eminent countryman, Sir Richard Morrison, by the representative of our most gracious Sovereign. It is no small addition to our pleasure to lay before our readers, in this day's publication, the honourable testimony of the satisfaction which that act of royal munificence has given to a body of gentlemen who, of all others, are best qualified to appreciate the value of the distinction, and to estimate the merits of the individual who has been thus selected for the rewards of her Majesty's favours.

But it is not alone as a favour to Sir Richard Morrison that this honour is to be considered. It is an honour conferred, in his person, on the noble art which, with such credit to himself, and benefit to the public, he has successfully cultivated. The honour due to Sir Richard for his individual merits, was due also to the profession of which he is and has been a distinguished member, and which he has been mainly instrumental in raising to its proper station of dignity and usefulness in this country, by concentrating its genius and its energy in the association from which this address emanates. It has ever been the policy and the practice of the illustrious house, of which her Majesty is no degenerate descendant, to encourage the fine arts by such honours on their professors as the State can confer; and, whilst we refer with pleasure to the distinctions conveyed, in their professional capacity, on a Reynolds and Chantrey, it gives us no less pride to find our countrymen—a Shee and a Morrison—equally honoured by the distinguishing approval of the Sovereign.

In this instance, at least, justice to the individual has been "justice to Ireland," honour to Sir Richard Morrison, an honour to his profession.

The address was presented to Sir Richard on the 5th ult., at his residence in Mount Street, by a distinguished deputation from the body, and read by John Papworth, Esq., the honorary secretary, after the following brief, but well conceived prefatory observations:—

"Sir Richard Morrison, the duty which devolves upon me this day, as secretary to the Royal Institute of the Architects of Ireland, I feel to be one of an extremely important and interesting nature, whether we consider it with reference to our own profession, or to the fine arts in Ireland. I am highly honoured to be the medium through which the sentiments of our institution are to be conveyed to you, on the occasion of that honourable distinction which has been conferred on you. I am aware my associates around me participate in the feelings of pleasure which I entertain at this moment. It is unnecessary for me, Sir, to dwell upon the circumstance which has brought us together this day, as it is fully expressed in the address which I shall now have the honour to read."—*Dublin Mail.*

SOCIETY OF ARTS FOR SCOTLAND.

January 25.—Dr. Fyfe, President, in the Chair.

Professor Forbes gave, at the request of the President and Council, an exposition of *The Doctrine of the Polarization of Heat.* On this evening he proposed to give an account of the instrumental measurement of temperature. This introduction was illustrated by examples of the various instruments in use, from the air thermometer of Sanctorius, to the delicate thermomultipliers of Nobili and Melloni. In the course of this historical account, he adverted to a recent ingenious improvement of the common flint thermometer, by M. Viiltz, and which, he believed was not yet published: this improvement consists in sinking the tube to the depth of two-thirds of its diameter into the material of the scale; by which arrangement the parallax in one direction is compensated by the refraction in another, so that, in all positions of the eye, the degree read off is the same.

A description of *A Self Inking Press* was read, illustrated by drawings and working model, by Mr. John Napier, which was remitted to a committee; and afterwards a short notice of the completion of the printing of the whole Bible in relief for the use of the blind, by John Alston, Esq., Rosemount (Glasgow; for which he was congratulated by the Society.

February 8.—Shirreff L'Amy, V. P., in the Chair.

The President read an interesting account of a series of extensive experiments *On the Evaporating Power of various kinds of Coal,* (including the anthracite), as obtained by combustion in furnaces. The general result of these experiments seemed to be that the practical heating power of all coals is almost exactly in proportion to the quantity of fixed carbon; there appearing to be no heat whatever procured from the volatile matter of the coal. This circumstance Dr. Fyfe accounted for by supposing that the hydrogen and volatilized carbon abstract, in passing to the gaseous state, as much heat as they develop during combustion.

Mr. Sang drew the attention of the Society to an erroneous deduction drawn by the late Capt. Henry Kater, from his experiments on *the flexure of bars.* Capt. Kater had observed that the elongation of the distance between two marks on the surface of a bar when the bar is supported at the middle, is but one-half of the elongation caused by supporting the same bar at the two ends, the same reduction on account of curvature having been allowed for in both cases. And he had thence concluded that the neutral plane is not, as is usually supposed, in the middle of the thickness of the bar, but only at one-third of that thickness from the convex side. Mr. Sang showed that this result would imply that bodies resist distention with eight times the energy with which they resist compression; and he pointed out that the disparity observed by Capt. Kater is due to the difference of curvature in the two states of the bar, and that that disparity agrees with the deduction of the ordinary theory of flexure. He also pointed out some errors in Capt. Kater's methods of computation and experimenting which seemed to him to destroy all confidence in any of that philosopher's experimental results.

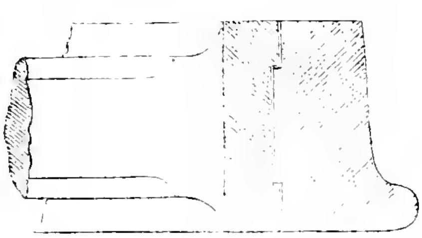
Royal Victoria Gallery, Manchester.—A long discussion has taken place at this institution upon Mr. Palmer's plan for the improvement of the Mersey and Irwell Navigation. In this discussion Mr. Radford, Mr. Hawkshaw, Mr. Buck and other eminent engineers took part: it is, however, reported at too great length to allow us to notice it this month. We are glad to see so much interest taken in engineering in that part of the country, and we should like to see Institutes at Manchester and Newcastle. The architects have already an Institute at Manchester, and the engineers should not be outdone.

Royal Scotch Academy. (From an Edinburgh Correspondent.)—This exhibition is now open, and it is an admirable one; the progress which is being made in art in this country is very satisfactory. There are few architectural designs, which is not to be wondered at, as the accommodation for drawings is miserable, every thing being sacrificed for oil paintings, the veriest daub in oil having a better place than a chef d'oeuvre in water colour. We are even worse off in this respect than you are in London, inasmuch as the little room given to our architecture and water colours is further curtailed by the introduction of the *sculpture!* the specimens of which, with the exception of the works, by members or associates of our Academy, are in most instances below criticism. Our Associations or "Art Unions" are reported to have larger funds this year than last, so that 8 or 9000 pounds will probably be spent in art this year. The last sum must be nearer the truth if general report may be depended on.

EXTRAORDINARY EXPERIMENT.

An experiment was tried on Saturday, 20th ult., of one of the inventions to which we alluded last autumn, which a friend on whom we have reliance had an opportunity of witnessing. The trial took place in the grounds of Mr. Boyd, in the county of Essex, a few miles from town, in the presence of Sir Robert Peel, Sir George Murray, Sir Henry Hardinge, Sir Francis Burdett, Lord Ingestrie, Colonel Gurwood, Captain Britten, Captain Webster, and some other gentlemen, who all appeared very much astonished at what they saw. By the kindness of the inventor our informant occupied a position that enabled him to command a view of all that took place. A boat 23 feet long and 7 broad was placed in a large sheet of water, the boat had been the day before filled in with solid timber, four-and-a-half feet in depth, crossed in every direction, and clamped together with eight inch spike nails. This filling in was made under the inspection of Captain Britten, who stated the fact to the distinguished gentlemen we have mentioned, and also that the inventor never went near the workmen employed, that no suspicion might be entertained of any combustible materials being lodged in the hold of the vessel. Several of the gentlemen were on Saturday rowed in a punt to the vessel, and examined for themselves, so that every doubt might be removed as to the cause of destruction being external, and not from the springing of any mine. When the different parties had taken up their positions, on a signal from the inventor, the boat was set in motion, and struck just abaft her starboard bow, and instantaneously scattered into a thousand fragments. At the moment of collision the water parted, and presented to the eye of our informant the appearance of a huge bowl, while upon its troubled surface he noticed a coruscation precisely resembling forked lightning. A column of water was lifted up in the air like a huge fountain, from which were projected upwards for many hundred feet the shattered fragments of the vessel, which fell many of them several hundred yards' distance in the adjacent fields. Our informant examined many pieces, and found the huge nails snapped like carrots: the mast looked like a tree riven by lightning, and never before, as he assures us, has he witnessed so sudden and complete a destruction, though he has seen shell and rocket practice on the largest scale. Such seemed to be the unanimous opinion of all present. How this mighty effect was produced was of course not disclosed to so numerous a party, but two naval officers present were perfectly aware of the mode of operation, and the inventor offered to go into details confidentially with one or two of the distinguished officers present. In answer to a question from Sir Henry Hardinge, the inventor stated that without a battering train he could transport on a mule's back the means of destroying the strongest fortress in Europe. No doubt this is very startling, but, hearing what we have, we cannot pronounce it impossible; and as in every particular the inventor has done what he has undertaken to accomplish, it is only fair to give him credit for the performance of more than has yet been disclosed. The existence of these tremendous powers is placed beyond all doubt, and the inventor asserts them to be completly under his control, which, from what our informant has had an opportunity of observing, he believes to be really the case. The instrument that wrought so terrible an effect on Saturday, lifting into the air a boat weighing two and a half tons, and filled in with five and a half tons of solid timber, and displacing at least fourteen or fifteen tons of water was only 18 lb. weight. Our informant has handled it and kicked it round a room when charged with its deadly contents, so portable and at the same time so safe is it—a point of vast importance, when we remember the daily accidents that are occurring from the detonating shells now used in our service. At Acre most of those employed burst before they reached their object, and they are liable to explode when rolling about a ship's deck, as was proved by the fatal accidents on board Her Majesty's ship Medea, off Alexandria, and the Excellent, at Portsmouth, and are dangerous to carry in a common ammunition cart on a rough road. Whether Lord Melbourne will condescend to examine into this matter, and secure these mighty powers for this country, or permit them to pass into the hands of our enemies, is more than we can venture to predict, but about which we cannot think England will remain indifferent. The inventor has requested us publicly to return his thanks to Mr. Boyd for his great kindness in permitting him the use of his grounds not only on this but on several occasions.—*Times.*

IMPROVED TIRE OF A RAILWAY WHEEL.



ANNEXED is a small sketch of a section of the tire of a railway wheel, showing a new mode of fixing the outer tire.

Many accidents, particularly to the machinery of locomotive engines, have occurred from the bolts (which are used in general, but in my improvement are not *necessary*) breaking, and allowing the tire to work off laterally, and to come in contact with the working gear. The improvement consists in having a groove turned out of the wheel, and a corresponding tongue on the inside of the tire, as shown in the sketch, which prevents the possibility of the tire coming off, but by its breaking, a contingency which but seldom happens.

H. W.

Manchester, Feb. 4th, 1841. *Railway Times.*

HISTORY OF THE LONDON AND BIRMINGHAM RAILWAY BY THOMAS ROSCOE,

ASSISTED IN THE HISTORICAL DETAILS BY PETER LECOUNT.

SIR—In your last number a communication appears from Mr. Lecount, animadverting on the use of his name in the above work, and also on the publishers for not paying him for his services. Having had the entire direction of the publication of this book, I feel it necessary to say that these statements are grossly incorrect, and that I am ready to prove this when called upon.

Mr. Lecount says "after page 32 I had nothing whatever to do with it, and my name being connected with it is a perfect hoax upon the public." So far from this being correct, I can produce scores of pages of Mr. Lecount's manuscript which are printed in various parts of the volume! It is extremely unpleasant to bring forward the names of gentlemen, and I will here merely remark, that the manner in which his name is printed on the title page of the volume, was agreed to by himself, in my presence, at the suggestion of his solicitor at Birmingham! Indeed if it were improperly used, an injunction could readily be obtained to restrain such an imposition on the public—but Mr. Lecount finds it easier to write scurrilous remarks, than establish that which has no foundation in truth.

By implication he charges the publishers with breach of agreement, wilfully mis-stating facts. He says, "what I furnished for that work although done under a written agreement, has never got me a sight of sixpence of the publisher's money." If such were in reality the case, Mr. Lecount would not be long in claiming his right. I deny, in unqualified terms, any treatment of Mr. L. otherwise than the most honourable. For what services he rendered, he was remunerated by having a pamphlet of about 100 pages printed, which was afterwards "wasted," a single copy only being kept to prove the fact of its having been printed; and I have now before me, in Mr. Lecount's hand writing, a memorandum of the cancelling of the original agreement which was for a pecuniary consideration.

I am, Sir, your obedient servant,

WAREING WEBB.

Castle Street, Liverpool,
February 18, 1841.

ERRORS IN SCIENTIFIC BOOKS.

SIR—It is a little surprising that a few of the most gross and palpable errors as represented in some of the Plates, both in the old and new editions of "*Tredgold on the Steam Engine,*" should have remained so long unnoticed, particularly in Europe, where so very many skilful and scientific mechanics are continually poring over works in every department of science.

The first and only error, I shall *now* draw your attention to, is on plate No. 11, where, in the figure of a steam engine pumping water from a mine, the pump rod is connected with the piston rod *i*, *h*, to produce a parallel motion in both it and the pump rod, which exhibits a profound ignorance of mechanics, on the very face of it, (as there delineated) for though the piston rod will move parallel, the lifting pump rod at the other end of the beam will not.

I have heard of a London waiter getting a quart of wine into a pint decanter, but never heard of the diagonal of a square (or of a parallelogram) being crammed into either diameter of it. I have heard also of a man who affirmed *that nothing was impossible, and that he could bite his own ear off;* but after repeated contortions of the head and other attempts and trials, he gave it up: observing, however, that he *knew it could be done with a sudden jerk.* Perhaps a diagonal can be crammed into the square, as represented in the figure alluded to, in Europe, but to us ignorant folks in the Western World it looks rather "*slanting-dicular,*" makes us rather sceptical, and indeed seems impossible to accomplish, even with a *sudden jerk:* but, like our inquisitive neighbours, the Yankees, if it *can be done,* we are "*kind o' curious*" to know *how.*

As books of science are generally published to instruct the unlearned or uninitiated, it would be as well to have the figure 5, on Plate X (A) *engraved so as to be understood,* because as there represented, it now requires a person who already understands his business, to understand how to construct the parallel motion *as there represented.* The same figure is repeated in the following plate, No. X (B).

If the insertion of this little inquiry is not inconsistent with your sense of duty to the public, please to notice it in your useful publication, and you may perhaps hear again from,

Your very obedient servant,

ROBERT RATIONAL.

British North America,
January 20, 1841.

REVIEWS.

Papers on Subjects connected with the Duties of the Corps of Royal Engineers. Vol. IV. London: Weale, 1840.

We mentioned in our last our favourable impressions as to the manner in which the character of this interesting work is maintained, and it gives us pleasure this month also to bear further testimony towards it.

The volume is appropriately preceded by a memoir of the professional life of the late Thomas Drummond, from the pen of Captain

Larcom, which, restricted as it necessarily is, still shows enough to enable us to appreciate the character of that amiable man.

The first, second, sixth and seventh papers are on subjects purely military, which prevents us, on the present occasion, from making any comment upon them.

The third paper, by Lieut. Nelson, R.E., is on the important subject of shot furnaces, a question in the consideration of which the construction of iron steam vessels should also enter. In this paper we are glad to see an acknowledgment of the valuable suggestions of Sir John Guest and Mr. Evans.

Lieut. Caffin's description of a new steam apparatus for drying gunpowder, shows that he has introduced an important improvement, which we trust will be adopted by the authorities.

The memoranda on blasting rock, by Major General Sir J. F. Burgoyne, form a work, and a most valuable one, in themselves: we cordially recommend them to the attention of our engineering readers of every department.

Major Harry Jones's paper, the eighth, gives an account of the well in Fort Regent, Jersey, a work of great difficulty and great success. Major Jones also gives his personal testimony to having witnessed the successful operation of the water finders with the *baguette divinatoire*. It is curious, but we do not know what to say to it.

Captain Brandreth's report on the Island of Ascension is valuable and interesting, but does not fall within the scope of our observations.

The tenth paper is by Major Bolton, R. E., and is descriptive of the dam constructed across the waste channel at Long Island, on the Rideau Canal. To this we may afterwards have occasion to refer.

Lieutenant Nelson has contributed a series of notes which he calls engineering details, a memoir which must be useful, both as an example and a lesson to the younger members of his corps.

The description of the New Victualling Establishment at Devonport bears ample testimony to the ability of the two Rennies, under whose direction many of the works have been executed. It will be seen, by other examples, that the civil engineer has full attention paid to him in this work.

Mr. Howlett, the chief draughtsman of the Ordnance, describes an ingenious plan of his for connecting a locomotive engine and tender to a passenger train, in which we only see one difficulty—how it would work on sharp curves.

Lieut. Denison, the able editor, is author of the fourteenth paper, on a new weigh bridge, lately erected at Woolwich Dockyard, and also of the next, containing an account of another new work in the same establishment, a single coffer-dam.

The sixteenth and seventeenth papers on injecting cement into leaky joints of masonry, and on the employment of sand for foundations, are translations from the French.

The eighteenth paper is on the rolling bridge at Fort Regent, Jersey.

The nineteenth paper brings us again to a contribution of the editor, describing the mode adopted for restoring the roof of Woolwich Dockyard Chapel, on the failure of the principals.

The twentieth paper is on the wharf cranes made by the Butterley Company, communicated by Joseph Glynn, Esq., F. R. S., and the twenty-first on Mr. Woodhouse's cast iron bridge over the River Trent, at Sawley, on the Midland Counties Railway.

Reports, Specifications and Estimates of Public Works of the United States of America. Edited by W. STRICKLAND, Architect, C. E.: EDWARD H. GILL, C. E.; and H. R. CAMPBELL, C. E. London: John Weale, 1841.

When the "Public Works of England" first appeared, we expressed our approbation of the superior manner in which Mr. Weale had brought out that valuable work, an opinion which was fully borne out by the countenance of the public, and the satisfaction of the profession. It is at once a proof and a result of the success of Mr. Weale's exertions, that our Transatlantic brethren have entrusted to his care a similar volume on the Public Works of America. It affords us double pleasure to see that they have commenced so well, and that they have taken such an effective step to do justice to their works. The present is a companion to the former work, and is fully equal to it, it shows the same careful selection of subjects, the same fulness of details, and the same splendour of execution. We have no doubt of its success with the profession, for every exertion has been made to deserve it, and it has our heartiest wishes, not less for its intrinsic merits than for the good it is calculated to do the profession. We know nothing better adapted to promote professional studies, and to elevate the character of such pursuits among the public, than the productions of works like these, which are the best monument to the old practitioner, and the best lesson to the beginner. This, we are sure, is but part of a series, for the success of the result we trust will embolden Mr. Weale to give us also the Public Works of the Continent, and thus lay the foundation of a museum of practical information, to which every department of the profession may have recourse.

We shall now proceed to detail the contents of the first two parts of the work before us. The first 13 plates represent the Philadelphia Gas Works, constructed in 1835, under the direction of Mr. Merrick: the following extracts will show their extent:

> The works are laid out in eight distinct sections of ten "benches," or thirty retorts each, making an aggregate of two hundred and forty retorts. Each bench yields upon an average 10,000 cubic feet of gas daily, or, when in full action, an aggregate of 800,000 feet.
>
> To each section is a distinct washer, purifier, condenser, and station meter. The two retort-houses are each 200 feet long and 50 feet wide, located in the centre of the square, having between them a passage of 40 feet, which is excavated as a cellar and floored over water-tight. This passage and the arched cellars under the retort-houses serve as coal stores.
>
> Each retort-house contains one stack and four sections of retort benches, built back to back down the centre of the building on each side of the chimney. The apparatus for cleansing the gas is located to the north and south of each retort-house respectively. Two sections of retort benches are now completed and in action, and a third is now in the course of erection.
>
> The retorts are the broad or York D's, 20 inches by 7½ feet in the clear, set upon an original plan.
>
> The gas is washed in two waters through washers of simple construction, with valves so arranged as to use either as the first, the most pure water being used as the second. The condensers are of ordinary construction, modified so as to enlarge the receptacle for the residuum at the base of the columns. The purifiers are constructed for dry lime, with a hydraulic seal for shitting, by which the use of valves in the purifying house is avoided.
>
> After passing the meters, the gas from all the sections mingles in the gasometers or gas-holders.

Appended to the description of the Gas Works there are some valuable reports upon the construction of the works, the cost of making gas, &c.

The next plate is a drawing of a Reservoir Dam across the Swatara. Plates 15 and 16 exhibit the construction of the Twin Locks on the Schuylkill Canal at Plymouth (U. S.) Plates 17 & 18 the bay of Delaware and the Breakwater in progress; the following extract from the report describes its magnitude: after examining into the construction of the Breakwaters at Cherbourg and Plymouth, the report recommends:

> The inward slope at 45°, the top 30 feet in breadth, and at 5⅓ feet above the highest spring-tide; the outward slope of 39 feet altitude, and of 105¾ feet base; both dimensions measured in relation to a horizontal plane passing by a point taken at 27 feet below the lowest spring-tide. The base bears to the altitude nearly the same ratio as similar lines in the profiles of Plymouth and Cherbourg Breakwaters.
>
> The part comprehended between the sea bottom and a horizontal plane 6 feet below the lowest spring-tide, the mass to be formed of stones weighing from ¼ to 2 tons, those of 2 tons comprising three-fourths of the mass. The slopes of this part to be covered with blocks weighing from 2 to 3 tons.
>
> For the part comprised between the latter horizontal plane and the lowest spring-tide, the mass to be composed of stones weighing from ½ to 2½ tons; those of 1½ to 2½ tons forming three-fourths of the mass. The slope of this part to be protected by blocks weighing 3 tons.
>
> For the part comprehended between the lowest and highest spring-tide, the mass to be formed of blocks weighing from 4 to 5 tons, and laid as regularly as practicable. The slopes of this part to be formed of the largest blocks and to be laid headwise.
>
> The estimate submitted by the Board was as follows:—The profile of the work rests on a bottom of $29\frac{1}{10}$ feet, on an average, below the lowest spring-tide, and has a superficies of 535.472 square yards; which, being multiplied by 1700 yards (the whole length of the work), gives for the capacity of the mass $910{,}302\frac{4}{10}$ cubic yards.

Plates 19 to 24 exhibit the construction of the Philadelphia Water Works, the following description will give an idea of their extent:—

> It has been from the commencement determined, for the present, to erect only three wheels and pumps, which are now completed, (there are now six), and with them the most important part of the duty of the Committee. The first of the wheels is 15 feet diameter and 15 feet long, working under 1 foot head and 7 feet fall. This was put in operation on the 1st of July, 1822, and it raises 1¼ million gallons of water to the reservoir in twenty-four hours, with a stroke of the pump of 4½ feet, a diameter of 16 inches, and the wheel making 11½ revolutions in a minute. The second wheel was put in operation on the 14th of September, 1822, and is the same length as the first, and 16 feet diameter; it works under 1 foot head and 7½ feet fall, making 13 revo-

lutions in a minute, with a 4½ feet stroke of the pump, and raising 1¼ million gallons in twenty-four hours. The third wheel, which went into operation on the 24th of December, 1822, is of the same size as the second, and works under the same head and fall, making 13 revolutions in a minute, with a 5 feet stroke of the pump, and raising 1¼ million gallons in twenty-four hours. It is not doubted that the second wheel can be made to raise an equal quantity; thus making the whole supply upwards of 4,000,000 gallons in twenty-four hours.

The wheels are formed of wood, and put together with great strength. The shafts are of iron, weighing about 5 tons each. The great size and weight of the wheel give it a momentum which adds greatly to the regularity of its motion, so necessary to preserve the pumps from injury under so heavy a head as they are required to work, which is a weight of 7900 lb.; the height 92 feet.

The following statement exhibits the extent of the works, the number of tenants supplied, the quantity of water daily distributed, and the amount of revenue for the years 1823 (at which time the city only was supplied with water) and 1837 respectively. In 1823 the three wheels and pumps were in operation, 6½ miles of iron pipes were laid, 4,844 tenants were supplied with 1,616,160 gallons of water daily, and the revenue was 26,191·05 dollars per annum. In 1837 six wheels and pumps are in operation, 98¾ miles of iron pipes are laid, 19,678 tenants are supplied with 3,122,164 gallons of water daily, and the revenue is 106,132·37 dollars.

Plates 25 to 40 contain drawings of Dams and Locks, and Aqueducts of various canals on the James River.

The reports and specifications, which are published in a separate work, are drawn up with considerable care, and show that the profession in America are well acquainted with the practical department of civil engineering.

Railway Transit: a Letter to the President of the Board of Trade. By Francis Roubiliac Conder, C.E. London: Weale, 1841.

In this pamphlet Mr. Conder has gone into the consideration of almost every detail connected with the working of a railway, illustrating the subject by many ingenious and practical suggestions. On most points we agree with Mr. Conder, although we must reserve our opinion as to some other of his suggestions. To the profession this pamphlet will be of great interest, as it advocates their cause with ability and justice.

A Manual of Logarithms and Practical Mathematics. By James Trotter. Edinburgh: Oliver & Boyd, 1841.

This work is from the pen of one of the tutors in the Scotch Naval and Military Academy at Edinburgh, and fully answers to its title. It is one of the best and cheapest manuals with which we are acquainted.

The Year Book of Facts in Science and Art for 1840. By the late Editor of the "Arcana of Science." London: Tilt, 1841.

We, in common with the scientific and professional press who contribute to the Year Book of Facts, may almost be considered as interested while speaking in favour of a work to which our own columns contribute; we are therefore obliged to leave it to the judgment of the public, by calling upon them to purchase and examine it for themselves. We cannot, however, refrain from saying that it is a most valuable compilation, indispensable to the student and man of science.

Gandy and Baud's Windsor Castle. London; Williams.

A third part has appeared of this splendid work, which we lately noticed. It contains a number of valuable and interesting engravings, so that the present subscribers have every reason to be gratified with the exertions of the editors, which we have no doubt will be farther successful in ensuring for it an extensive circulation.

Description of a new Quart and Bushel Measure, by T. N. Parker, Esq., M.A., is a pamphlet on a new system of measures. Mr. Parker proposes that the gallon shall contain 256 cubic inches, so as to give greater facilities in calculation.

A new coloured lithograph of *Menai Bridge* by Mr. Ganci, has appeared—we recommend it to the attention of our readers.

Tyas's National Map of England.—We have before us a proof of No. 11 of this cheap and excellent map, which for clearness of execution, and accuracy, we believe to be superior to any map of its scale, extant, it shows nearly the whole of Sussex, with a large portion of Kent and Surrey. It is so arranged that every sheet is perfect in itself, or any number of sheets may be joined together.

A new edition will shortly appear of Peckston's Practical Treatise on Gas, with numerous plates, corrected and adapted to the present improved state of the manufacture.

NEW IMPROVEMENTS IN THE DAGUERREOTYPE.

On the 4th of January, at the sitting of the Institute, M. Arago announced that M. Daguerre had discovered the means of fixing the Daguerreotype pictures in the wonderful short space of half a second, or in other words instantaneously. This quite unexpected result will henceforward enable the Daguerreotype operator to obtain the representation of living and moving objects, of all which animate a picture. Our streets, squares, bridges and rivers, will not be as before, represented in the middle of the day plunged into a deadly solitude, but they will show us in reality all the animation which gives interest to a picture. The admirers of the Daguerreotype, and they are numerous among the well educated part of the community, are eagerly awaiting the disclosure of the important improvements of M. Daguerre, and we are sorry to hear that the ingenious inventor will not be able to bring his improvements before the public for a few months to come.

We understand that the improvements consist only in shortening the time of the operation, and that the effect produced will not be better than before. In fact we have with infinite gratification admired the specimens obtained by the original plan, which are exhibited by Messrs. Claudet and Houghton, in their numerous and beautiful collection, and we cannot conceive how it would be possible to improve them, except by the addition of living or moving objects.

STEAM NAVIGATION.

RENNIE'S PATENT TRAPEZIUM PADDLE WHEELS.

The object of the above patent is to do away with the defects of the common rectangular paddle wheel, arising out of its great width, weight, and indirect action, and to substitute in its place a wheel which, while it retains the simplicity, obviates the defects of the common paddle wheel. The Trapezium paddle wheel differs only from the common paddle wheel in the form of its floats, which are trapezoidal or spear-shaped, and in the greater simplicity of its construction. The advantages to be derived from this form are a wheel of one half the breadth, one half the weight, and one half of the surface of the common recangular paddle wheel. These advantages require no comment, provided that the form of wheel be equally efficient, and this has been proved by a series of experiments on two separate steam vessels, in opposition to their usual wheels. From the peculiar form of the floats, they enter into the water with the pointed part of the float downwards, and thus gradually arrive at their full horizontal action without shock or vibration, while, after the stroke, they, in the reverse manner, quit the water without raising any portion of it behind. Of course the advantages, arising out of the diminished breadth of a vessel fitted with trapezium-shaped floats, will be, less space occupied in a river, basin, or lock; less surface resistance to a head wind, by all the breadth of one wheel; lighter draught of water, by the diminished weight; less oscillation sideways, and consequently less liability to occasion damage to the engines. The shocks and vibrations now experienced by the striking of the edges of the rectangular paddle wheel against the surface of the water, and the loss of power occasioned in consequence by the oblique action of the wheels both in going into and out of the water will be entirely prevented. Finally, that that the Trapezium paddle wheel will work nearly as efficiently when deeply immersed as when immersed to the usual depth, thus enabling the wheels to work with nearly the same facility at the first as at the last part of a vessel's voyage. All these advantages are obtained without the aid of wheels, eccentrics, or complicated levers of any kind, but simply an alteration in the form of the floats; H. M. ship *African* is now being fitted with Trapezium paddle wheels, instead of her former rectangular paddle wheels.

North American.—In a week or ten days (says the *New York Herald*) one of the most substantial and splendid steam ships in the world will be launched in this city. This steam ship, or steam frigate rather, is owned by Nicholas, Emperor of Russia. She is of immense size, and has been building since last spring. Her dimensions are as follow:—Length of deck 220 feet; length of keel 210 feet; breadth 36 feet; full depth 21½ feet; tonnage 1,500. She is constructed of live and white oak, but mostly of the latter kind, weighing, we believe, about fifty pounds to the cubic foot. She will draw, when launched, ten or eleven feet of water and no more. But when her engines, and boilers, and guns, and all her machinery and her fuel of which she can carry [illegible] eight hundred tons, [illegible] she will pro[illegible] [illegible] The [illegible] of this great war steamer was [illegible] by two officers of the Russian Navy. [illegible] of the steam frigate—no vessel of the kind that [illegible] crossed the A[illegible] [illegible] She is superior to the *Western*, the *Queen*, and the *President*. Her bows are sharp—her stern is round—her lines [illegible] gradual and symmetrical—her wheel-houses [illegible] and not too large, and her whole appearance is rich, attractive, and manof-war like. She has three masts, which, together with her rigging, are very light. This will contribute, in a great degree, to her speed against head winds. Large [illegible] spars are decidedly bad, when winds are unfavourable. Her internal arrangements will be [illegible] [illegible] Her armament is to be very formidable. She can discharge at every broadside more than four hundred pounds of shot! She will mount sixteen fifty-four and thirty-two pounders on the second deck, and two ninety-six pounders hollow shot, called by the humane, death dealers, on the upper deck, which is flush fore and aft—a clear run of two hundred and twenty feet. Her engines will be about six hundred horse power. They will be [illegible] to the ship, for no expense is to be spared in having them perfect. What her speed will be, is, of course, not yet known. We can only guess that she will go pretty fast, if not faster. Another account says—A splendid steam frigate, built at New York, for the Emperor of Russia, was launched on the 24th November. She is to be called the *Kamtschatka*, and is of the burden of 2,281 tons, of the length of 240 feet 6 inches. Breadth across the paddle wheels, 66 feet. Her armament is to consist of twelve 36 pounders, four 54 pounders, and two 96 pounders for throwing hollow shot.

Steam Navigation.—If the French Government carry their projection for admitting the importation of foreign marine steam engines free of duty, it will give extensive employment to the engine manufacturers in this country, and greatly extend French steam navigation.

West India Mail Steam Packet Company.—This Company have in hand 14 steam vessels of 1400 tons burthen, each to be fitted with a pair of engines of 220 horse power—6 pair are being made in the Clyde, 2 pair by Fawcett and Co., 2 pair by Maudslay and Field, 2 pair by Miller, Ravenhill and Co., and 2 pair by Acraman and Morgan—the parties are under heavy engagements to have them ready within a very short time.

New York.—We believe that we are at last enabled to announce the establishment of a New York line of steam ships between New York and England. The preliminaries are, we understand, nearly completed, and within a short time the keels of four gigantic vessels will be laid. They are to be about 2,000 tons, with engines of 800-horse power.—*New York Commercial Advertiser.*

The City of Dublin Steam-packet Company.—We understand that this Company have decided on laying down two new steamers immediately, to run in conjunction with their unrivalled vessels, the *Prince* and *Princess*, to and from Kingstown. As the utmost speed that can be attained is determined on without regard to expense, the contracting parties are bound, under heavy penalties, to construct them to outstrip any sea-going steamer afloat; and it is confidently anticipated, that the average passages will not exceed nine hours.—*Liverpool Albion.*

PROGRESS OF RAILWAYS.

GRAND JUNCTION RAILWAY.

Expenditure to December 31, 1840.

Engineering, surveying, parliamentary, legal and general expences; construction of line and works, stations, land and compensation, rails, chairs, &c.	1,616,606	10	10
Locomotive engines and tenders, and establishment—carriages, wagons, trucks, and horse boxes	228,694	16	0
Purchase of Warrington & Newton line	65,463	7	4
Purchase of Chester and Crewe line	192,550	0	0
Expended to Dec. 31, in works, &c. on Chester & Crewe line	65,475	14	3
Interest on loans previously to the completion of the line	22,270	18	3
Arrears of fourth call on half-shares, less received on account of fifth call on do., and Warrington & Newton interest not applied for	1,585	8	9
Total	£2,192,046	15	5

Value of Stock, December 31, 1840.

Locomotive Engine Department	109,215	6	8
Waggon, horse box, and carriage truck department	53,451	7	5
Coach-building department	51,843	14	3
Total value	£214,510	8	4

Manchester and Birmingham Railway.—The Directors of the Railway have, by a *unanimous* vote, awarded to John Byth, Esq., V.P. of the Architectural Society of London, and R. Cromwell Carpenter, Esq., F.S.A., the premium of two hundred pounds for their designs for the Manchester Station.

The Strasburg and Basle Railway Company has just received from the bank of France the sum of 1,200,000f. on a warrant from the treasury, being the first of the three instalments of 12,000,000f. which the French government is authorised to lend it. The Company therefore is about to adopt additional measures for carrying on their works.

LONDON AND BIRMINGHAM RAILWAY.

Expenditure to December 31, 1840.

To land and compensation	721,556	17	3
To works of road and stations	4,348,269	12	5
To locomotive stock, viz.—engines, tenders, tools, and implements	154,635	0	7
To carrying stock, viz.—coaches, trucks, wagons, cranes, &c.	195,310	5	0
To charges, viz.—			
Obtaining act of incorporation	72,858	18	10
Law charges, conveyancing, engineering, advertising, and printing, direction, office expenses, salaries, and sundries	172,175	9	0
To interest on loans, previous to general opening, 17th Sept. 1838, and debenture charges	127,649	8	6
Total	£5,792,475	8	7

Value of locomotive engines and carriage stock, Dec. 31, 1840	£319,945	5	7

394,088 passengers travelled on this railway during the last year, each an average distance of 65½ miles.

LONDON AND GREENWICH RAILWAY.

Extracts from the last Report.

The cost of locomotive power, per train, has been 1s. 2¾d. per mile.

Relaying of the line, together with the asphalting over nearly 500 arches have been completed, and the new rails on cross sleepers laid thereon, and, so soon as the season of the year will permit, the remainder will be proceeded with.—1,506,730 passengers were safely conveyed over this line during the past year.

In conformity with an act obtained last session, empowering the Company to increase the width of the railway from the London station to the junction with the Croydon Railway, so as to admit of four lines of way instead of two, as heretofore, two contracts have been entered into for widening the railway as above mentioned, and which extend over about 2,400 yards, leaving only about 660 yards of the line and the addition to the station to be contracted for. A list of the tenders for the first contract was given in the Journal for last December, and we now annex a list of tenders for the last contract.

Messrs. Little & Sons	£16,350
Messrs. Lee	17,628
Mr. Jackson	17,650
Messrs. Grissell & Peto	17,734
Mr. Grimsdell	17,986
Mr. Munday	17,988
Messrs. Ward	18,650
Mr. Bennett	18,764
Messrs. Baker & Son	19,340
Mr. Mac Intosh	21,283

BLACKWALL RAILWAY.

List of Tenders for the extension from the Minories to Fenchurch-street, delivered in on the 23rd ult.

Jackson	£29,800
Webb	30,333
Baker and Son	31,888
Lee	32,333
Piper	32,690
Grissell and Peto	33,000
Grimsdell	33,120
Cubitt	33,940
Bridger	34,900

Stockton and Hartlepool Railway.—On Tuesday the 10th ult., this new Railway was opened by the Directors, and on the following day to the public. It connects the flourishing ports of Stockton and Hartlepool, and must prove a convenient means of communication between the two places. The undertaking altogether reflects the highest degree of credit on the public-spirited company who are engaged therein, and also on the talented engineers and their assistants, and the contractors who have been employed in executing the work. In point of fact, we shall not overstate our feeling on this subject, if we remark that the way in which the works have been finished on the Stockton and Hartlepool railway affords a model of railroad construction. Messrs. George Leather and Son, of Leeds, are the engineers-in-chief, and Mr. John Fowler, their assistant, was the resident engineer.—*Leeds Mercury.*

Railway to Cambridge.—In the last month there have been no less than three different surveys between Bishops Stortford and Cambridge, one for extending the line of the Northern and Eastern Railway to the latter place; one line by the East Anglian Railway; and the other for the railway to York, through Lincoln. We certainly think it a great fault in the present state of affairs for new companies, as in the above case, to attempt to do too much. It would have been far better for the projectors of the lines from Norwich and York, to have made an arrangement with the Northern and Eastern Railway Company to have completed their line to Cambridge, from which the other two lines could then have diverged, and at some future time a line to the westward, through Bedford to Rugby, and unite with the London and Birmingham Railway. By such a step the expense of conflicting surveys, and perhaps of a parliamentary contest would be avoided, and the Eastern Counties really benefited.

The Sheffield and Manchester Railway.—It appears the works in the centre tunnel are going on night and day, the men working in shifts." But when we find it is three miles, or 5,280 yards in length, and there are five shafts sunk of the following depths, some time must elapse before this great work is finished:—Shaft No. 1, 180 yards deep; No. 2, 194 yards; No. 3, 169 yards; No. 4, 193 yards, No. 5, 135 yards.

The Cromford and High Peak Railway.—The application of the locomotive engine to the purposes of railway transit on this line, was made about a fortnight since, several of the proprietors accompanying the engine. The intention is to construct, as speedily as possible, two more engines to work the two twelve mile levels between Hopton and Buxton, at a rate of from ten to twelve miles per hour, so as to enable the Company to transport goods and passengers to Whalley Bridge in a few hours, instead of two days, which it now usually takes.—*Sheffield Iris.*

The Taff Vale Railway.—The operations for finishing the line are going on with great vigour, particularly at the Merthyr Terminus, where a great number of men, carpenters, masons, and labourers are at present busily employed. The damage caused by the late sudden rise in the river, has, we are glad to hear, been greatly overstated, as a comparatively small sum will suffice to repair it. A wall is now building on the bank of the river, which will be built so strong as to prevent the recurrence of a like calamity, and the void caused by the earth having been carried away is now being filled up.—*Monmouth Gazette.*

Great North of England Railway.—Mr. Storey has resigned the office of Engineer-in-chief, who has been succeeded by Mr. Robert Stephenson.

ENGINEERING WORKS.

Crown Point Bridge.—The Commissioners of the Crown Point Bridge and Roads met at the Court-house, in Leeds, on Monday the 15th ult., for the purpose of letting the works of this bridge, when tenders were received from many highly respectable contractors, and the competition was, we are informed, exceedingly close. The bridge is to be thrown over the river Aire, a little above the Nether Mills Weir, or from Chadwick's dye-houses on the south side (part of which will have to be removed in order to make way for it), to Medley's Oil Mill on the north side; and when the roads to and from its site are completed, it will open out a direct communication from Hunslet-lane and the southern parts of the town to York-street and the northern and eastern district of the town. The design for the iron bridge, prepared by Messrs. George Leather and Son, the engineers, of this town, is one of the most tasteful and elegant we have ever seen, combining in a remarkable degree symmetry and lightness with strength. The bridge will be of one arch, including in its span the whole width of the river and the towing path on its side. The span will be 120 feet, (that of Victoria bridge being only 80 feet), the rise of the arch 12 feet, but the height, from the water of the river to the waterside, of the arch at the crown will be 17 feet, and to the roadway of the bridge about 22 feet. The width within the parapets will be 42 feet; there being a Macadamized carriage way of 10 yards wide, with a footpath or causeway of two yards wide on each side. The arch upon which the road is to be constructed will be entirely of iron; the abutments and wing walls will be of stone. The total weight of iron is estimated at about 420 tons. The masonry was let to Messrs. Bray and Duckett, who have executed works in a very creditable and satisfactory manner on the North Midland Railway, and who are also contractors for the works now in progress for the Leeds Waterworks Company, on Woodhouse Moor. The ironwork was let to Messrs. Booth and Co., of Park Ironworks, Sheffield, who are also a firm of the first respectability. The sum at which the bridge let for was, we understand, £8,750, being somewhat lower than the estimate of the engineers, so that the commissioners have every reason to consider the bridge favourably let, not only as regards the respectability of the contracting parties, but also as regards the terms on which it was taken. The work will be commenced forthwith, and the terms of the contracts are such as to ensure its being carried forward with vigour, and it is confidently anticipated that this bridge may be opened for the use of the public at the close of the present year.—*Leeds Mercury.*

Portsmouth Harbour.—A most complete survey of the Portsmouth Harbour, with its various lakes and approaches, has recently been made by Lieuts. Sherringham and Otter, and their assistants, including a minute map of the towns. The most extraordinary coincidence exists, we understand, between the present survey, with all the improved methods, and still more improved instruments, and the old survey of Mackenzie, made in 1782, and the still more recent one of the late talented and industrious Mr. Park, who was then Master Attendant here; and, still more extraordinary, the soundings, all over, have varied only in the slightest degree in the period alluded to, 60 years. The bar off the Southsea land-marks remains unaltered from its shape and size as recorded in the oldest minutes; and we find it consists of no shifting matter, but is a firm substance of flint and chalk, almost concreted together with gravel; it could be channelled with much ease, but with some expense.

The Shannon Improvement.—Two steam dredging machines have commenced operations on the shoals of the river near Banagher. One of the machines it is stated, removed 38 tons of clay intermixed with gravel in 20 minutes. Besides the dredging operation, works have been contracted for at Killaloe, Meelick, Banagher, and Athlone.

An Iron Bridge has been constructed at Nantes, on the same principle as that adopted by M. Polonceau, on the Pont du Carousel, drawings of which and a description will be found in the 2nd volume of the Journal. The bridge of Nantes is of one arch, about 66 feet span, and the width of the road way 40 feet.

MISCELLANEA.

Artificial Staining of Marble.—This art was practised by [illegible] and is described by Zanon [illegible] considerable [illegible] at Verona. The results are as follows:—A solution of nitrate of silver penetrates the marble, and communicates a deep black colour to it. A solution of nitrate of gold penetrates less deeply, and communicates a beautiful purple violet colour. Verdigrise sinks to the depth of a line into the marble, and gives it a fine green colour. A solution of dragon's blood communicates a beautiful red colour, and gamboge a yellow tint. To apply these two colours it is necessary to polish the marble with a pumice stone, to dissolve the gum resins in hot alcohol, and put them on with a camel-hair pencil. The tinctures obtained from woods, as Brazil wood, logwood, &c., penetrate deeply into marble. Tincture of cochineal, with the addition of a little alum, gives marble a fine scarlet colour, similar to African marble. Artificial orpiment produces, when dissolved in ammonia, a lively yellow colour. If verdigrise be boiled with white wax, and the mixture be applied to the marble, and then removed when it has cooled, it will be to have penetrated five lines, and to have produced a fine emerald colour. When it is wished to apply the different colours in succession, some precautions are necessary. The tinctures prepared by spirit of wine and by the oil of turpentine are to be applied to the marble while it is hot; but the dragon's blood and gamboge are to be used with the marble when cold. For this purpose, it is necessary to dissolve them in alcohol, and employ the solution of gamboge first. This, which is clear, soon becomes turbid, and affords a yellow precipitate. Those parts of the marble which are covered with the tincture are then to be heated, by passing over them, at the distance of half an inch, a red-hot iron plate, or a charcoal chauffer; it is then allowed to cool, and the iron is again passed over those portions where the colour has not penetrated. When the yellow colour has been imbibed, a solution of dragon's blood is to be applied in the same manner; and, while the marble is hot, the other vegetable colours may be communicated. The last colours to be applied are those in union with the wax. These must be used with great caution, because the slightest excess of heat causes them to penetrate deeper than is necessary, which renders them less adapted for delicate work. During the operation, cold water should be occasionally thrown upon them.—*Athenæum.*

Height of Waves.—The highest wave which struck the French ship *Vénus,* during her voyage, was 7·5 metres (23 feet); the longest wave was met with in the south of New Holland, and was three times the length of the frigate, or 150 metres (492 feet).

The quantity of Air necessary for the Healthful Respiration of the Horse.—The Committee of the Academy of Paris, to whom this question was referred by the Minister of War, have reported, that in a building where the air is properly renewed, and that result is effected by a skilful and efficient system of ventilation, a horse can never suffer, so long as he has from 25 to 30 cubic metres of air.

A new method of nailing deck plank has been adopted in the upper deck of the Driver steamer, the invention of Mr. Blake, by which the expense of copper or composition nails in the deck may be saved, simply by punching the nails down one inch, and filling the hole with a circular plug dipped in white lead.

Reflecting Telescope.—Unfortunately Sir William Herschel never made public the means by which he succeeded in giving such great development to this telescope, and the construction of a large reflector is still a perilous adventure. According, however, to a report by Dr. Robinson to the Irish Academy, Lord Oxmantown has overcome the difficulty, and carried it to an extent, which even Herschel himself did not venture to contemplate, the illuminating power of this telescope, along with a sharpness of definition little inferior to that of the achromatic; and it is scarcely possible, he observes, to preserve the necessary sobriety of language in speaking of the moon's appearance with this instrument, which Dr. Robinson believes to be the most powerful ever constructed. However, any question about this optical pre-eminence is likely soon to be decided, for Lord Oxmantown is about to construct a telescope of six feet aperture, and fifty feet focus, mounted in the meridian, but with a range of about half an hour on each side of it.

Hotel de Trémouille.—All who take an interest in Parisian antiquities, may be glad to know, that the demolition of the Hôtel de Trémouille, in the Rue des Bourdonnais, is not to include that of the beautiful little tower which forms the conspicuous ornament of its principal court. The proprietors have presented this fine relic of the architecture of the 13th century to the city,—and it is about to be transported to the Museum of Historical Monuments.

Head of the Laocoon.—The following statement has appeared in the French papers, and is professedly contained in a letter from M. Valmore, an artist at Brussels—"In the gallery of the Duke d'Aremberg there are many things which are not known to any but the initiated. Among them is *the original head of the Laocoon.* This fine group, when first discovered in Italy, was," as is generally known, "without the head of the father, and an arm of one of the sons. The head was supplied by a celebrated artist, who copied it from an antique bas relief. Some time afterwards, the original was found by some Venetian connoisseurs, and was ultimately sold to the grandfather of the Prince for about 160,000 francs, and brought to Brussels. When Napoleon, during the Consulate, had the group transported into France, he knew that the real head was in possession of the Duke, and offered him his weight in gold for it. This was refused; and as it was known that Napoleon was not scrupulous in gratifying his desires, the Duke d'Aremberg sent this *chef-d'œuvre* to Dresden, where it remained concealed for ten years, but was brought back again into Brussels, when Belgium became tranquil. It expresses, in the highest and most admirable degree, moral grief mingled with physical pain. The compression of the teeth and contraction of the lower jaw are almost too horrifying to be long contemplated; and yet in this intense expression of suffering there is not the slightest grimace. The pupils of

[illegible]

B[illegible] [illegible] Mr. [illegible] has [illegible] modelled bust [illegible] from the portrait lately [illegible] by Mr. Briggs. He has [illegible] the same [illegible] Edward Perkins, the elder Brunel, and Hubbard, several [illegible] readers must have seen in the Adelaide and Polytechnic Gallery.

A Society of Architects has been formed in Paris, having as its "leading [illegible] to unite with a common circle those architects who present the necessary [illegible], and to study questions of art and practise, viewed principally [illegible] public and private interest."

Cornwall.—A new Episcopal Chapel is now erecting at Flushing, in the parish of Mylor. The building is constructed from the designs, and under the superintendence of Mr. Wightwick, of Plymouth. It is in the Anglo-Norman style, and calculated to accommodate 250 sitters, without reckoning the gallery, which it is not proposed in the first instance to erect. Lord Clinton is the chief private subscriber, and the London Incorporated and Local Diocesan Societies, have afforded also liberal assistance.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 30TH JANUARY, TO 23RD FEBRUARY, 1841.

Six Months allowed for Enrolment.

Charles Schafhautl, of Swansea, Doctor of Medicine, Edward Oliver Manby, and John Manby, of Parliament Street, Civil Engineers, for "*improvements in the construction of puddling, balling, and other sorts of reverberatory furnaces, for the purpose of enabling anthracite, stone coal or culm to be used therein as fuel.*"—Jan. 30.

James MacLellan, of Glasgow, Manufacturer, for "*an improved combination of materials for umbrella and parasol cloth.*"—Jan. 30.

Ezra Jenks Coates, of Bread Street, Cheapside, Merchant, for "*improvements in the forging bolts, spikes, and nails.*" Communicated by a foreigner.—Jan. 30.

Henry Pape, of Great Portland Street, Piano Forte Manufacturer, for "*improvements in castors.*"—Feb. 1.

Charles Hood, of Earl Street, Blackfriars, Iron Merchant, for "*improvements in giving signals.*"—Feb. 1.

William Wilkinson Taylor, of Barrowfield House, Essex, Gentleman, for "*improvements in buffing apparatus for railway purposes.*"—Feb. 1.

Dominic Frich Albert, of Cadishead, Manchester, L.L.D., for "*an improved or new combination of materials and processes in the manufacture of fuel.*"—Feb. 1.

Francis Sleddon, jun., of Preston, Machine Maker, for "*improvements in machinery or apparatus for roving, slubbing, and spinning cotton and other fibrous substances.*"—Feb. 2.

William Ward Andrews, of Wolverhampton, Iron-monger, for "*improved methods of raising and lowering windows and window blinds, and opening and shutting doors, which are also applicable to the raising and lowering of maps, curtains, and other articles.*"—Feb. 2.

Thomas Young, of Queen Street, London, Merchant, for "*improvements in furnaces or fire places for the better consuming of fuel.*"—Feb. 3.

William Hancock, jun., of King Square, Middlesex, Accountant, for "*an improved description of fabric suitable for making friction gloves, horse-brushes, and other articles requiring rough surfaces.*"—Feb. 3.

Joseph Bunnett, of Deptford, Engineer, for "*certain improvements in locomotive engines and carriages.*"—Feb. 3.

John Cartwright, of Loughborough, Manufacturer of Hosiery, Henry Warner, of the same place, Manufacturer of Hosiery, and Joseph Haywood, of the same place, Frame, Smith, for "*improvements upon machinery commonly called stocking frames or frame work knitting machinery.*"—Feb. 4.

Thomas Griffiths, of Birmingham, Tin Plate Worker, for "*improvements in such dish covers as are made with iron covered with tin.*"—Feb. 8.

James Thorburn, of Manchester, Mechanist, for "*certain improvements in machinery for producing knitting fabrics.*"—Feb. 8.

William Ryder, of Bolton, Lancaster, Roller and Spindle Maker, for "*improved apparatus for forging, drawing, moulding, or forming spindles, rollers, bolts, and various other like articles in metals.*"—Feb. 8.

Thomas Fuller, of Salford, Machine Maker for "*improvements in machinery or apparatus for combing or preparing wool or other fibrous substances.*" Partly communicated by a foreigner.—Feb. 8.

Elisha Oldham, of Cricklade, Wilts, Railroad Contractor, for "*improvements in the construction of turning tables to be used on railways.*"—Feb. 8.

Charles Green, of Birmingham, Gold Plater, for "*improvements in the manufacture of brass and copper tubes.*"—Feb. 8.

William Wigston, of Salford, Engineer, for "*a new apparatus, for the purpose of conveying signals or telegraphic communications.*"—Feb. 8.

Joseph Scott, of Great Bowden, near Market Harborough, Timber Merchant, for "*improvements in constructing railways, and in propelling carriages thereon, which improvements are applicable to raising and lowering weights.*" Feb. 8.

James Johnstone, of Willow Park, Greenock, Esquire, for "*improvements in motive power.*"—Feb. 8.

William Henry Fox Talbot, of Locock Abbey, Wilts, Esquire, for "*improvements in obtaining pictures or representations of objects.*"—Feb. 8.

William Edward Newton, of Chancery Lane, Mechanical Draughtsman, for "*improvements in obtaining a concentrated extract of hops, which the inventor denominates 'humuline.'*" Communicated by a foreigner."—Feb. 8.

Theophilus Smith, of Attleborough, Farmer, for "*improvements in ploughs.*"—Feb. 15.

James Whitelaw and George Whitelaw, Engineers, of Glasgow, for "*a new mode of propelling vessels through the water, with certain improvements on the steam engine when used in connexion therewith, part of which improvements are applicable to other purposes.*"—Feb. 15.

Philip William Phillips, of Clarence Place, Bristol, Gentleman, and William Bishop Beck, of Broad Street, Bristol, Wine Merchant, for "*improvements in four wheeled carriages.*"—Feb. 15.

James Ransome, and Charles May, of Ipswich, Machine Makers, for "*improvements in the manufacture of railway chairs, railway or other pins or bolts, and in wood fastenings, and trenails.*"—Feb. 15.

William Scamp, of Charlton Terrace, Woolwich, Surveyor, for "*an application of machinery to steam vessels, for the removal of sand, mud, soil, and other matters from the sea, rivers, docks, harbours, and other bodies of water.*"—Feb. 16.

William Samuel Henson, of Allen Street, Lambeth, Engineer, for "*improvements in steam engines.*"—Feb. 16.

George Edward Noone, of Hampstead, Civil Engineer, for "*improvements in dry gas meters.*"—Feb. 18.

William Orme, of Stourbridge, Ironmaster, for "*improvements in the manufacture of coffered spades, and other coffered tools.*"—Feb. 18.

John Collard Drake, of Elmtree Road, Saint John's Wood, Land Surveyor, for "*improvements in scales used in drawing, and laying down plans.*"—Feb. 18.

Anthony Bernhard Von Rathen, of Kingston-upon-Hull, Engineer, for "*improvement in fire grates, and in parts connected therewith, for furnaces for heating fluids.*"—Feb. 22. (Four months.)

William Newton, of Chancery Lane, Middlesex, Civil Engineer, for "*improvements in the process of and apparatus for purifying and disinfecting greasy and oily substance, or matters both animal and vegetable.*" Communicated by a foreigner.—Feb. 22.

Thomas William Booker, of Merlin, Griffiths Works, near Cardiff, Ironmaster, for "*improvements in the manufacture of iron.*"—Feb. 22.

Jonathan Guy Dashwood, of Ryde, Isle of Wight, Plumber, for "*improvements in pumps.*"—Feb. 22.

Moses Poole, of Lincoln's Inn, Gentleman, for "*improvements in tanning, and dressing, or currying skins.*" Communicated by a foreigner.—Feb. 22.

Charles Sneath, of Nottingham, Lace Manufacturer, for "*improvements in machinery, for making or manufacturing of stockings or other kinds of loop work.*"—Feb. 23.

John Dean, of Dover, Chemist, for "*improvements in preparing skins and other animal substances, for obtaining gelatine, size, and glue, and in preparing skins for tanning.*"—Feb. 23.

TO CORRESPONDENTS.

A. Q. Z. *We cannot give the description he requires, it has already appeared in several publications.*

G. H. S. *The rules he requires we shall publish at some future opportunity, but not at present.*

Mr. Hance's *communication will be noticed next month.*

The Wesleyan Centenary Hall and Mission House next month.

An Old Subscriber *will feel obliged if any of our readers can inform him, the process of printing Transparent Window Blinds.*

Communications are requested to be addressed to "The Editor of the Civil Engineers and Architect's Journal," No. 11, *Parliament Street, Westminster.*

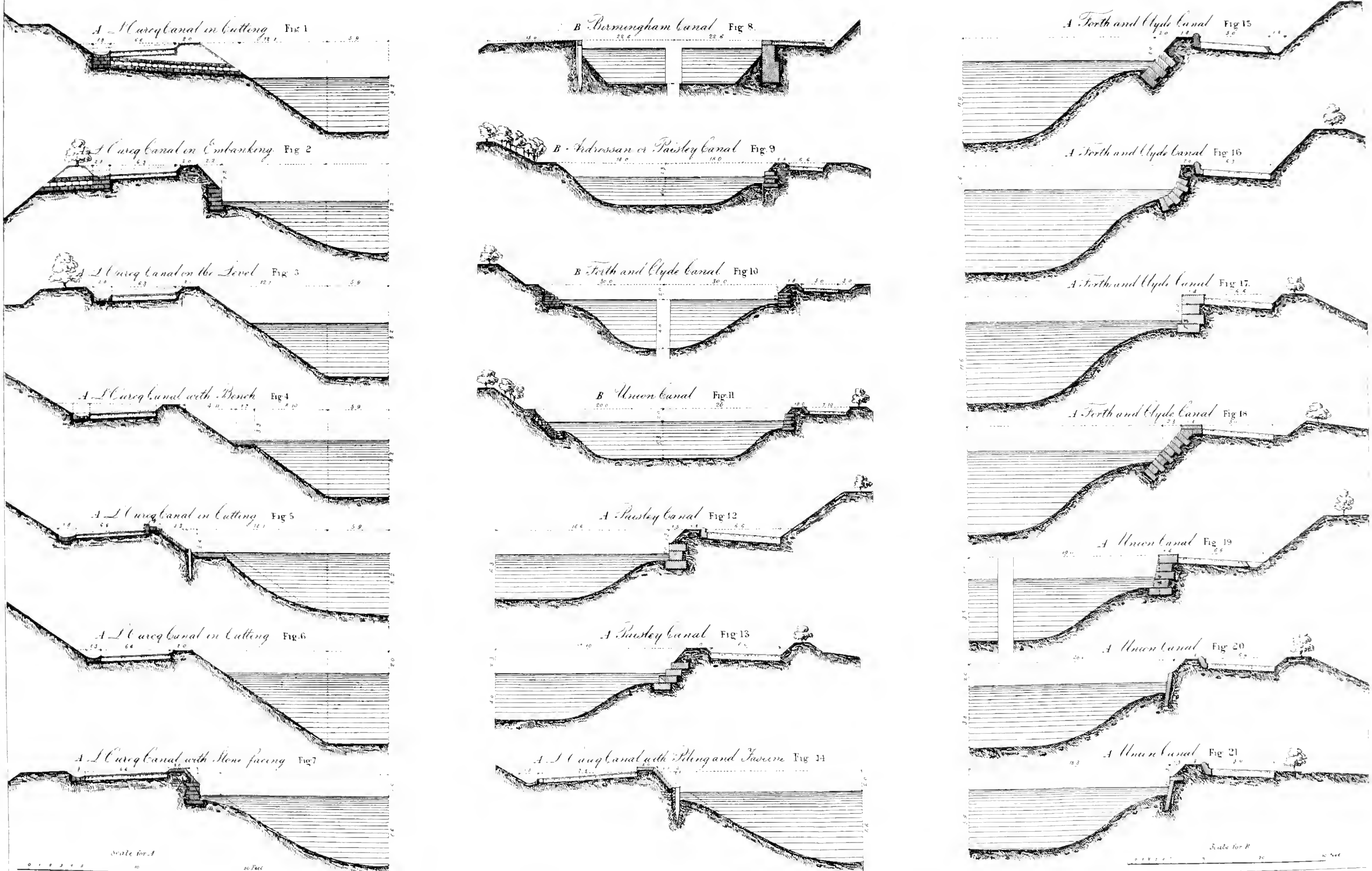
Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

ERRATUM.

At page 58, line four from the top of the first column, for "In all *our* architectural drawings," read "In all *old* architectural drawings."

CANALS.


A L'Ourcq Canal in Cutting Fig 1
A L'Ourcq Canal on Embanking Fig 2
A L'Ourcq Canal on the Level Fig 3
A L'Ourcq Canal with Bench Fig 4
A L'Ourcq Canal in Cutting Fig 5
A L'Ourcq Canal in Cutting Fig 6
A L'Ourcq Canal with Stone facing Fig 7
Scale for A
B Birmingham Canal Fig 8
B Ardrossan or Paisley Canal Fig 9
B Forth and Clyde Canal Fig 10
B Union Canal Fig 11
A Paisley Canal Fig 12
A Paisley Canal Fig 13
A L'Ourcq Canal with Piling and Fascine Fig 14
A Forth and Clyde Canal Fig 15
A Forth and Clyde Canal Fig 16
A Forth and Clyde Canal Fig 17
A Forth and Clyde Canal Fig 18
A Union Canal Fig 19
A Union Canal Fig 20
A Union Canal Fig 21
Scale for B

NOTES RELATIVE TO TOWING PATHS AND BANKS OF CANALS IN GREAT BRITAIN.

By M. Vuigner, Inspector of the Paris Canals.

(With an Engraving, Plate IV.)

(Translated from the French.)

M. Vuigner, being commissioned by the company of the Ourcq and St. Denis canals to study the various systems of works in use on the British canals, and particularly to examine the different methods used in forming the foundations of the hauling or towing paths, and protecting the slopes of the interior banks from the effects produced by the ordinary and irregular fluctuations of the water, he visited, for this purpose, in the course of 1837, the canals of that country, which stand the first in construction, and collected considerable information on the subject.

In England the canals of Taunton & Bristol, those of Birmingham, (from Liverpool to Leeds) Preston & Lancaster, in Scotland those of Paisley or Ardrossan, the Forth and Clyde, and the Union Canals, furnished him with every information that could be required. On his return to France, the company, who wished to establish on the Ourcq canal a set of passage boats, empowered M. Vuigner immediately to apply the information he had acquired. He was first engaged to macadamize the towing path of the left bank of the Ourcq canal between La Villette and Meaux, and caused part of its banks to be improved, and he also applied some improvements resulting from his observations in Great Britain.

The present paper will contain a description relative to the *metalling* of the towing paths, and the protecting of the banks on the English and Scotch canals, as well as describing the macadamizing and facing used on the Ourcq canal to prevent damage by the action of the water.

Towing or Hauling Paths.

In England there is generally only one towing path, though, upon some new lines, especially the Birmingham, there are two paths. This is an exception which a particular circumstance required, but which, however, is not a deviation from the general rule. The Birmingham has a towing path on both sides until it is divided into two branches, one to Wolverhampton, and the other to Walsall, each having their towing paths, one on the right side and the other on the left. On that part where there is a towing path on each bank, the navigation is extremely active, amounting to more than 1000 boats per week. The navigation is facilitated, and at the same time the horses that tow the boats coming from Wolverhampton and Walsall have not to change their sides, nor obstruct one another. The breadth of the towing paths is generally not more than 10 feet, which is considerably less on some canals, and especially at Taunton, a canal of very small section, navigated by boats of only 10 tons.

On the new line of the Birmingham canal, the breadth of the towing path in cuttings is about 12 feet, and on embankments 15 feet. The path is generally divided into three parts, one part next the canal forms a fender or raised mound 1 ft. 6 in. to 2 feet wide, which is turfed over, the middle part forms the trackway for the horses, and is covered with metalling or broken stone to the width of five or six feet, and the other part is the remainder of the land unappropriated; sometimes it contains a drain for carrying off the surface water, and is enclosed with a hedge which determines the limit of the canal property. On the opposite bank, there is, in some parts, a footpath about 3 feet wide, but more frequently the underwood or cultivated land reaches to the water's edge, so that no more land is taken than what is absolutely necessary for the canal.

On the Preston, Lancaster, Paisley, Forth & Clyde, and Union Canals, where there are fast passage-boats, the width reserved for the fender between the towing path and the interior slope of the canal, is on the average two feet wide at the base, and raised from 6 to 8 inches above the path, or from 2 ft. to 2 ft. 6 in. above the surface of the water, the top, about 1 ft. to 1 ft. 4 in. wide, is generally turfed over. The interior edge forms the continuation of the interior slope of the canal, and the outer edge is sloped and protected with large round pebbles placed at intervals of 2 to 3 feet, which are partly imbedded in the earth, and project about 2 inches above the fender: these pebbles are now abandoned, as they were found inconvenient for the towing ropes when the speed was slackened. On some parts of the canals the fender is formed of flat stones, the edge of which forms the top of the stone facing of the bank, as shown in sections, Figs. 17, 18, and 19. The fenders answer the purpose for limiting the track of the horse, preventing the mud being washed over the path, and a protection to the edge of the slope.

The towing path of the above canals is mostly formed of a layer of broken or round pebbles laid to a thickness of 4 to 6 inches according to the nature of the soil, and then covered with a layer of gravel from 1 in. to 1½ in. thick. On some parts marly clay is used to bind the pebbles, and on other parts, especially at the stopping places, at the bridges, and even the whole length of the Paisley canal, the pebbles are covered with a layer of iron slag, which, when well beaten in, forms a path extremely hard and compact, besides, it is not slippery in rainy weather, and is free from dust in summer. The broken pebbles used are generally not larger than 1½ inch at most. The best macadamized paths are those made of broken limestone, and better still with basalt; these materials are found nearly every where on the banks of canals, which renders their formation and repair very cheap.

The transverse slopes of the towing path, where there are fast passage boats, have an inclination of about 2 inches to the yard declining from the canal: this inclination is found to give the best hold for the horses' feet. The surface water is carried off on the outside of the path, and is seldom allowed to run into the canal, excepting in such parts where the canal is formed in cutting; it is then carried off by under drains of dry stones, which pass under the towing path transversely from longitudinal gutters or drains, formed on the outside of the path.

Towing Paths of L'Ourcq Canal.

The towing paths of this canal, and in general on all the French canals were formed on the natural soil, without the least metalling or stoning of any sort: in winter time they were quite impassible in parts, especially in the Paris division, between La Villette and Claye. In this state of things it was difficult to think seriously of establishing passage boats, which the Ourcq and St. Denis canal company was desirous of introducing into France; they therefore determined upon adopting the English system of macadamizing the towing path of the left bank of the Ourcq canal between La Villette and Meaux. On the Ourcq canal the ordinary boats are towed up by one horse; but the passage boats, as well as the Government boats, are towed by two horses abreast, as well going up as down, which is still the case. The experiments which were made on the speed of passage boats, showed that three horses, two horses abreast in front and one behind, were necessary for towing these boats. It thus became necessary to increase the width of the towing path. In those places where the banks had retained their first form the breadth of the path was 13 ft., which was diminished to 11 ft. 6 in., where the banks were raised 1 ft. 6 in. above the surface of the water. The towing path is now reduced throughout to a breadth of 9 ft. 6 in., consisting of a fender 2 ft. wide at the base, the trackway for the horses 6 ft. 6 in. wide, and a drain 13 inches wide. In the Meaux division they have only allowed a breadth of 6 feet for the towing path, but the drain has been increased to 19 inches wide, which still gives a breadth of near 8 feet upon which the horses can walk or run with ease. This breadth might be considered insufficient at the points of crossing, where four horses have to pass; but the company decided that in case that should occur, they would cause the front horses to be harnessed one before the other. Another important consideration which determined the company to adhere to 9 ft. 6 in. was that of economy, as it would involve an extension of the work for more than 30 miles between La Villette and Meaux, and double that distance if extended between La Villette and Mareuil.

Experience has proved that the adopted width is sufficient for the different boats, as the horses of the passage boats in general never pass each other, excepting at the different stages, where the path is widened. As regards the horses of the other boats when they pass, the horses go a little on one side, or on to the exterior slopes, and if it be found too inconvenient to act thus, it is immediately obviated by harnessing the horses one before the other as before observed.

The breadth being settled, it then became necessary to fix the height of the towing path above the surface of the water. Between La Villette and Meaux the top of the interior slope was 8 ft. above the bottom, but between La Villette and Claye it was only 6 ft. 6, and from Meaux to Claye 5 feet, so that the same height of path could not be adopted throughout. Between La Villette and Meaux the height of the fender was fixed at 2 ft. 6 in. above the soffice of the water, and 6 inches above the towing path, which made the latter 2 feet above the water, as shown in sections, Figs. 5, 7, & 11.

The paths were formed in some places with broken limestone, in other places with clean pebbles mixed with sand or coarse gravel, and laid to a thickness of 4 to 5 inches, and covered with a layer of gravelly sand from 1 in. to 1½ in. thick; the pebbles, when mixed with coarse gravel, were used without an extra coat, and laid to a thickness of 6 inches. As soon as the paths were finished, a roller 5 feet broad, drawn by 3 horses, were passed over them: this roller was constructed on the Polonceau principle, and made of wood lined on the inside with lead, and the outside covered with sheet iron, and filled with sand: it weighed 3 tons.

Interior Slopes.—In ordinary canals the exterior slopes are frequently of earth turfed, and if they have stone or timber facing at any point it is generally in those places where there are wharfs, however, on the Birmingham Canal stone and timber facings have been substituted in the upper part for earth banks, the slopes having been preserved below the surface of water as a counterpoise to the masonry and timber work, this method shown in section fig. 8, allowed the wharf walls to be made thinner, and the stakes or piles of the timber facing to be reduced to a minimum length. Thus the foundation of the masonry hardly goes down to the level of the bottom of the canal, and the piles are not driven to a greater depth, these piles are placed from 3 to 4 feet apart from centre to centre, and have a capping or campshed 7 inches square, which serves as a support to the planks placed behind to keep up the ground between one pile and another: these timber facings are very simple and very cheap, and may be made at all seasons without forming a coffer-dam, or laying the canal dry.

Ardrossan or Paisley Canal.

The section of this canal is shown in fig. 9, the breadth at top is 35 feet, depth below the ordinary surface of the water 4 feet, and 6 feet from the top of the banks to the bottom. The banks are faced with stone as shown in figs. 9, 12, and 13. In section fig. 9, the stone facing is laid 16 inches below the water surface, and 12 inches above: it is constructed with 4 courses of rough stone laid dry and scabbled on the face, the lower course projects forward, and small stakes are driven every 2 feet at the base, to protect the stone work. Section fig. 12, is constructed in a similar manner, excepting the stones are larger and in 3 courses, and have no stakes to protect the foundation. Section fig. 13, has 4 courses of large stones as fig. 9, but they are set like steps. These two last sections were only tried by way of experiment, that which is now adopted is shown in fig. 9, it gives the greatest resistance, and is best calculated to deaden the action of the waves, or surge of the water, and at the same time the most economical.

Forth and Clyde Canal.

This canal has a mean breadth of 60 feet at the top, and 8 feet deep below the water surface, and 12 feet deep below the top of the bank; different methods of lining the banks have been adopted to prevent the abrasion of the banks by the action of the water, occasioned by the establishment of quick passage boats, as shown in sections figs. 10, 15, 16, 17 and 18. On the towing-path bank of section fig. 10, the facing is laid in the same manner as in fig. 9, of the Ardrossan Canal, excepting the courses of stone are more numerous, and there are no stakes to protect the foundation. On the opposite bank, as those points most likely to be affected, they are cased with rubble work. Section fig. 15, shows a broad bench at the bottom, and the stone facing laid on a slope of 45°, which is carried up to one foot above the water surface. Section fig. 18, the stones are laid on a slope and continued up to the top of the bank, which is capped with a flat stone 1 foot 8 inches wide. Section fig. 16, shows another method of construction, the stones are laid to the form of the curve of degradation: the stone work does not extend more than 12 to 15 inches below the water level, and the same same height above. Section 17, consists of 4 courses of basalt, each 10 inches high and 1 foot 8 inches to 2 feet deep, it is carried up to the top of the bank, the top course oversailing at the back, and forms the fender.

These different systems of stone facing for banks have been tried on a scale sufficiently large to form a tolerably correct judgment as to their expense and efficiency. The last section fig. 17, is evidently the best, but the cost is very high, and the same may be said with regard to section fig. 18, besides neither of these two last sections have the advantage of deadening the effects of the wave. The section ultimately adopted is that shown in fig. 10, its cost is 2*s.* 1*d.* per yard forward.

The Union Canal.

This canal has a breadth of 40 feet at the top, and a mean breadth of 37 feet on the line of the water surface, the depth below this line is 5 ft. 3 in. and 4 ft. 6 in. to 2 ft. 3 in. more to the top of the banks. This section, as will be presently described, is more favourable for passage boats than the section of the Forth and Clyde Canal.

It is on this canal that stone facing have been adopted to the greatest extent since the establishment of passage boats, and on which circumstances have been most favourable for this description of traffic. The same systems have been tried as on the Ardrossan and the Forth and Clyde Canals, but the nature of other materials on the spot have caused the adoption of a different system for those canals, more simple in operation and better adapted to effect the end proposed. The section fig. 11, shows the stone facing of the bank, it is nearly similar to those of the Forth and Clyde Canal fig. 10. On the towing-path bank there is however a slight batter or inclination given to the facing, and also on the opposite bank are laid large pebbles placed irregularly to a certain thickness, instead of rough stone.

A considerable length of bank is faced with stone as shown in section fig. 18, of the Forth and Clyde Canal, and another system has been tried similar to section fig. 19. But the facings adopted and generally followed are those shown in sections figs. 20 and 21. In section fig. 20, stone slabs of different lengths, from 28 to 32 inches wide, and 2½ to 3 inches thick form the facing, they are sunk into the clay puddle of the bank: it was found that the upper part of the facing was not sufficiently firm, consequently another narrow slab was laid on the top horizontally, as shown in fig. 21, which prevented the pressure of the earth against the top of the facing, and made a base for the turfing of the slope of the fender.

The facings of the towing-paths on the banks of the Union Canal, between Falkirk and Edinburgh, have been made the same as the two last methods just described, nearly throughout the whole length, and in some cases the opposite bank also. This description of facing has an excellent effect, both as to appearance and as to its operation on the waves of the canals. The joints being well secured, no water can get in to injure the bank, and this plan which gives the best appearance to the work, is in reality the most economical, the cost being only from 2*s.* 6*d.* to 3*s.* per yard forward, while the work in fig. 11, costs from 3*s.* to 4*s.* The reason for this cheapness is the abundant supply on the spot of a slaty stone well adapted for the purpose.

Canal de L'Ourcq.

The canal de l'Ourcq had already suffered very much from the action of the water, on the two banks between la Villette and Claye, when it was proposed to run passage boats upon it. It therefore became necessary to repair the banks, and the expense of stone facing on the English plan, and the want of good materials rendered a distinct course necessary. The canal company having a large quantity of brushwood and cuttings, wished to have a trial made to protect the banks with fascine work, as in section fig. 5. Stakes of oak 4 inches thick were therefore placed at every twenty inches distance, and driven into the ground 2 ft. 3 in. to 3 feet deep, and fascines placed behind them. It was soon found, however, that the fascine work was ineffective, as the water got in during the undulations, and on retiring carried away the earth. The fascines have therefore been removed, and oak planks laid behind the stakes, as shown in fig. 14. This plan, there is every reason to believe, will prove cheap and work well.

On other parts of the works another plan, as shown in figs. 2 and 7, has been adopted, like that on the Ardrossan and Forth and Clyde Canals. The works however get on slowly on account of the difficulty of finding stones large enough.

RAILWAYS BILL.

Since our last number, Mr. Labouchere's bill has made farther progress, and such is the want of effective opposition, that it would doubtless have passed through all its stages by this time, had not Sir Robert Peel interfered to get it referred to a select committee. From this committee, however, we expect little good, although Sir Frederick Smith is said to have been sorely discomfited in his examination by Sir Robert Peel, when his incompetency was shown so fully as to have been convincing to the minds of unprejudiced persons. Mr. Labouchere felt this, and was in the greatest possible rage, so that, to cool himself, he endeavoured to harrass several of the witnesses in such a manner as to call down the remarks of the chairman, although he effectively succeeded in frightening some parties.

The opposition, as it is called, which is now being carried on, proceeds from a committee of the delegates of boards of directors, who have overstepped their powers, and are disunited among themselves. Several of the chief of the delegates are, indeed, publicly charged with giving underhand support to the Government plan, while they throw every obstacle in the way of those who attempt to carry on the opposition in earnest. From such parties no good can be expected under any circumstances, and we need scarcely say that they are totally unfitted for defending the interests of the engineers, which, by the Government attempts, are the most threatened. The delegates are all from railways which have their bills, and most of them from finished lines. Chairmen of companies of course care nothing about how the engineers are likely to be interfered with, neither do the directors of finished railways care one straw about what measure is meted out to the projected lines; on the contrary, they would willingly give every aid, as they have shown, towards casting obstacles in their way. Narrow or broad gauge, six or four wheeled engines are nothing to directors, but they are great things to engineers, who are not likely to be best pleased with the exercise of their profession, when it is to be ruined by being placed under the tampering knick-knackery of a railway inspector, who entered on his duties ignorant of the works he was called on to inspect, and who has distinguished himself ever since by his disposition to foist his own crotchets, in opposition to the experience of other men. Although Sir Frederick Smith does not claim the power of meddling with engineering details at present, he evidently reserves it, and we have, in the report of the horse marine steam-boat inspectors, a pretty good inkling of the kind of interference which they ultimately look forward to. We have seen one difference of opinion already, and we ask what farther we have to expect from the forbearance of the government jobbers. A pretty pass affairs have come to in the profession, when the Stephensons, Brunel or Locke, are to knuckle down in their own department to a military engineer, to come like petty schoolboys and recite their tasks to a dabbler in the art, themselves have created. The statues of Smeaton, Watt and Telford, may tremble on their pedestals at this insult to their successors. What tribunal would be called upon to decide if men at the head of the law or medical profession entertained a doubt? Is there any tribunal? We think there is none. The government would think otherwise; the course they would adopt would be to send the Lord Chancellor or Lord Denman, Sir James Clarke or Sir Henry Halford, to some one in the lowest ranks of their professions. We consider the interference of the government with engineering, as a gross insult to the profession. They would not refer the fortification of Chatham to us, why then should military engineers be sent to interfere with railways?

It is the eleventh hour, but we call again on the engineers to come forward, and to resist these encroachments ere it be too late. Government cares nothing for their interests, neither do railway directors, so that the only way engineers have of protecting them, is by protecting them themselves. The injury threatened by the government is very great, no one can tell the greatness of its extent, for one successful attack upon the liberties of the profession cannot fail to lead to farther inroads. Let the engineers do as the marine engineers did last year, and as they mean to do this, unite, and we have no doubt that the jobbers will be defeated. If, however, they like to be under the dominion of the one-tailed bashaw in Whitehall, they will remain supine and allow themselves to be sacrificed. We call upon them therefore to lose no time in organizing an opposition. The Institution of Civil Engineers we feel are particularly called upon, and we consider that they will grossly neglect the interests of the profession if they do not immediately send a petition to both Houses of Parliament, praying that no government interference with the profession may take place. The engineers generally should also meet, and send similar petitions, and a committee should be formed to oppose the bill at its future stages.

ENGINEERING WORKS OF THE ANCIENTS, No. 3.

MINES OF THE THASIANS.—SIPHNIANS.—ATHENIANS.

Continuing our extracts from Herodotus, we find that the Thasians derived considerable wealth from their mines. From those of gold at Scaptesyla they obtained upon an average eighty talents; Thasos itself did not produce so much; but they were on the whole so affluent, that being generally exempt from taxes, the whole of their annual revenue was two hundred, and in the times of the greatest abundance three hundred talents. It may be observed that many of the Greek states derived considerable revenues from mines, which admitted of the application of slave labour on a large scale. So with some of our modern states mining and mining monopolies are important sources of income. Of the Thasian mines, Herodotus remarks, that he had seen them, the most valuable were those discovered by the Phenicians, who also were engaged in the Cornish tin trade, and in working the mines of Spain. The Phenicians are stated by our author to have first made a settlement on the island under the conduct of one Thasus, and to have named the island after him. The mines so discovered were between a place called Ænyra and Cœnyra. Opposite to Samothracia was a large mountain which by the search after mines was effectually levelled, from which it is evident that the working was surface working. The Thasians also, according to the testimony of Thucydides, had some valuable mines on the coast of Thrace. If the mining of the Thasians was confined to surface-working, it could scarcely be from want of a knowledge of other modes, as we shall see by the example of the Samians that tunnelling was carried on upon a large scale. The Siphnians were also a mining people, their soil producing both gold and silver in such abundance, that from a tenth part of their revenues, they had a treasury or cash-box, as we should call it, in the general bank of Greece at Delphi, equal in value to the richest which that temple possessed. Their power was consequently considerable, and they were at one time the richest of all the inhabitants of the islands, although their territory was but small, being one of the seventeen small islands opposite Attica, called the Cyclades. This isle is now called Siphanto, and although it no longer has mines of gold and silver it still has plenty of lead, which the rains discover. The Siphnians every year made an equal distribution among themselves of the produce of their mines, as did the Athenians of that of the silver mines of Attica. In allusion to stream-works, Herodotus says that the Indians obtained great abundance of gold, partly by digging, and partly from the rivers. Of the Ethiopian gold our author speaks, but does not say how it was obtained. Tin is mentioned as being obtained from the Cassiterides, supposed to be the Scilly Isles, of which Herodotus says that he has little information.—The north-west of Asia is represented as abounding with gold, but how it was obtained was not known. This passage might refer to the mines of the Ural.

WORKS OF THE SAMIANS.—TUNNEL.—AQUEDUCT.—MOLE.—ENGINEERS.

The Samians were distinguished among the Greeks for their engineering monuments, for which very reason Herodotus says that he was particular in his account of those islanders. Of these works, remains to this day exist. Through a high mountain they are said to have cut a passage, seven stadia (about a mile) long, eight feet high, and as many wide. By the side of this was a canal or aqueduct three feet in breadth, and twenty cubits, according to our author, in depth, but in this there must be some mistake.—In this canal pipes were laid conveying to the town the water of a copious spring, supposed to be that of Metelinous. Another work is the Mole now forming the left horn of Port Tigrani. According to Herodotus, it was two stadia or more in length, and twenty orgyiæ or cubits in height. The engineer of the tunnel was Eupalinus, the son of Naustrophus, and an inhabitant of Megara.

TRENCH OF THE SCYTHIANS.—WALLS—BRIDGES.

The descendants of the slave population having revolted against the Scythians, intersected the country with a deep trench, supposed to have separated the Crimea from the mainland. In the time of the Emperor Constantine Porphyrogenitus this was filled up, it must however have existed for a long period. In Scythia are also mentioned bridges and walls constructed by the Cimmerians.

Polybius.

CARTHAGINIAN ENGINEERING.—BRIDGE OVER THE MACAR.—NEW CARTHAGE CANAL.—GOD OF MINING.

From Herodotus we come to Polybius, but it is to be regretted that the latter has rather applied himself to accounts of political intrigues than the descriptions of the physical features of the countries on which he writes. From him therefore we are enabled to glean but little information, and that of a most discursive character. He gives several hints showing us the capacity of the Carthaginians for engineering, but he has not entered into those explanations which would have come with weight from him as an eye witness. The passage of the Alps, by Hannibal, is sufficient to prove the skill of the Carthaginians, but we have too vague a description of the mode of proceeding to allow us to profit by it.

In the 1st book chapter 6, a singular account is given of a bridge near Carthage, which was laid over the Macar, a deep and rapid river, scarcely fordable in any part. This was the only bridge on the river and formed one of the passes to Carthage. On it Polybius states that a town was built by the soldiers and used as a garrison. The roads in the neighbourhood of Carthage were mostly made by great labour.

In their military operations the Carthaginians were well accustomed to pass rivers, instances of which we have in the course of Hannibal's expedition.—His passage of the Rhone belongs rather to military tactics, but there is one point to which we think it necessary to allude, as it may be of interest to our bridge engineers. Having formed a me of large boats across the river, he made use of them as a coffer-dam or breakwater, and under the shelter of them, passed over the troops in canoes, and swam over the horses, which were guided alongside of the vessels by men stationed on board of them.

At Nova Carthago (Carthagena) in Spain, one of their principal colonies, we again find traces of their engineering works, between the lake and the sea they cut a narrow navigable canal, and across this there was a bridge used by carriages and beasts of burden. In the city, one of the hills was dedicated to Aletes, who is said to have obtained divine honours, from having first discovered the silver mines, which were extensively wrought by the Carthaginians in Spain.

GREEK ENGINEERING—BRIDGES—PHŒNICE—PSOPHIS.

In Epirus we find mention of a bridge, which seems to have been after the fashion of that at Babylon, mentioned in our first article, and to have been of a class common among the ancients. This was at Phœnice, and had piers of stone with moveable planks laid upon it. At Psophis in Arcadia a bridge is mentioned over the Erymanthus, a great and rapid stream.

CAUSEWAY—AMBRACUS.

Ambracus in Etolia is described as a fortress of considerable strength situated in the middle of a marsh, and secured by a wall and outworks It was only to be approached by one narrow causeway. It was besieged and taken by Philip king of Macedonia, who carried causeways through the marsh.

SIZE OF FORTS.

Speaking of Tichos, a fortress near Patræ, Polybius says that it was of no great size, being not more than a stadium and a half in circumference, so that it might have sides of eighty yards in length.

ENGINEERS.

Among the supplies furnished by the Rhodians to the Sinopeans in their war against Mithridates,* engineers are mentioned, and military engines.

REBUILDING OF RHODES.

On the destruction of Rhodes by an earthquake, large supplies were sent by the allies of that city in order to enable them to rebuild it. Among these supplies Ptolemy, king of Egypt, sent forty thousand cubits of square pieces of fir; a hundred architects, and three hundred and fifty labourers. Antigonus sent them ten thousand pieces of timber, that was proper to be cut into solid blocks from eight to sixteen cubits: five thousand planks of seven cubits; three thousand weight of iron. Seleucus his father sent ten thousand cubits of timber.—Other parties sent in the same proportion.

Building materials seem to have been considered as of great value, for in case of the sacking of towns the timber and tiles were frequently carried off.

EPISODES OF PLAN.

(Continued from page 71.)

Although they may seem to betray a consciousness of the weakness of our cause, upon the principle of *qui excuse, accuse*, we have considered the preceding remarks necessary, in order to combat the opposition which the system we would recommend is likely to encounter. But it would be a positive weakness on our part, were we to assume a deprecatory and apologetic tone, as if we had misgivings of our own, and accordingly threw ourselves entirely upon the indulgence of our readers, for presuming to bring forward what its novelty alone may be thought to condemn. The starting matters altogether so new is in itself an act of presumption, if merely because it is a tacit reproach upon the indolence, the indifference, or ignorant carelessness of those, who, having had the opportunity, have never touched upon, or called attention to them; consequently sinning as we do to that extent, we may dispense with what would be as troublesome to ourselves, and as impertinent towards our readers, as it would be useless—namely, any affectation of modesty.

Be it said that opportunities for applying any striking combinations of plan, even in the way of episodical parts in a building, are of rare occurrence, that ought to be a *raison de plus* wherefore every thing like an opportunity should be eagerly caught at, and turned to the utmost account. So far from which being the case, it appears to be especially shunned. There are some hundreds of seats and residences throughout the country, from which, putting them all together, hardly half a dozen fresh ideas are to be obtained. That they may be "goodly houses,"—well built, and containing well proportioned, expensively and luxuriously furnished rooms, is not denied. Their plans may be perfectly unexceptionable as regards comfort and convenience,—free from aught amounting to a fault, or even to a blemish, nevertheless as insipid and uninteresting as possible. Look at the majority of the plans given in Richardson's Vitruvius Britannicus,—which, it may be presumed, are rather above than under the average: do they offer a single happy architectural point worth studying? Yet in houses of the class there shown, some merit of that kind might reasonably enough be expected. The chief lesson to be derived from them is that both their employers and architects themselves are satisfied with the very first ideas that come *to hand*—and the hand seems to have more to do with such matters, than the mind. Exceptions, it is true, are to be found; yet they are merely the *rari nantes in gurgite vasto*;—which circumstance, however, much as it is to be regretted in itself, has its convenience, because all the examples of that kind might be collected together within a moderate compass: and it has frequently struck us as rather singular that no one should hitherto have brought out a publication devoted entirely to a series of studies of interior architecture, elucidated not only by plans and sections, but perspective views also, for the purpose of showing effects. Of course we would have only the very cream served up, without a particle of that "thrice skimmed sky-blue," which architectural caterers are too much in the habit of imposing upon their customers.

Were it properly got up, some such work as what we have just pointed out, would be found eminently instructive, particularly if accompanied by *pentimenti and variations* of the plans (in wood-cuts), showing the same general ideas differently modified. It is true, something of the kind may even now be picked up out of architectural publications: but then it is not from such as are to be met with in a moderate collection, or as are likely to fall in the way of students. Neither are such subjects satisfactorily elucidated, when they occur merely as parts of general plans and sections, in which latter far more is sometimes left unexplained and doubtful, than is actually shown. It may be said, and very truly so, that the want of any work of the kind has not been felt, or else we should have had not only one, but a number of them ere now, as in all such cases supply invariably keeps pace with demand. Yet, if this cannot be disputed, it seems to us only an additional proof of the utter disregard paid to the subject itself; as if any thing would do for interior architecture, and that nothing more is required in the way of designing than to be able to draw the doors, chimney-piece, and cornices of the rooms in a section. An architect, it would seem, requires no instruction for designing the interior of a building, except what he can gather from his own observation and practice; positive lessons and studies for the purpose, are quite unnecessary. There he may safely be left entirely to his own guidance; although, if such be the case, we do not see, wherefore so many finical rules should be deemed necessary for even the most trivial circumstances in external architecture,—more especially as those petty rules are after all little better than impertinences, for those who are worthy of the name of artists are guided by something better, while those who are not, blunder on by help of rules, pretty much as they would blunder on without them. Hardly can it be said that there is less occasion for the student's directing his attention to interior arrangement and design, than to exterior architecture, there being, according to the doctrine of chances, quite as much probability that he may have at least one opportunity of displaying his taste and ability in planning and decorating a moderate sized yet recherché residence, as that he will ever be called upon to erect a palace, a senate-house, a cathedral, a museum, or in short any one of those *pleasures* upon which academical students are set to work their wits before they are capable of producing a single new idea on a moderate scale.—To be sure there is less study required for producing something catching on a large scale, where the "lion's-hide" pompousness of the subject conceals the inanity and poverty of the conception.

Probably the remarks we have just made, will be considered quite irrelevant and impertinent; and that they are somewhat ungracious we admit—would to Heaven! they could be proved to be utterly unfounded and unjust!—But of introductory observation our readers have by this time had enough—more than may be altogether palatable: it behoves us therefore, now to come at once to our professed subject; which is, indeed, one both so new in itself, so complicated, and of such extent, as to render the task we have undertaken rather an embarrassing one. We do not pretend, however, to treat it systematically, proceeding gradually from the simplest elements of plan, to the most varied combinations of them; but shall merely in the first instance, enumerate some of the leading circumstances by which different con-

* Polybius book 4, chap 5

binations may be obtained, and then exhibit some detached *Episodes*, and individual instances. Hitherto, *Plan*—by which we mean not only the outline of the floor, but that of profile and section likewise—has been allowed to exhibit scarcely any variety, effect being almost exclusively limited to that kind of it which arises from material, colour, and decoration. Accordingly if it can be shown that there are other sources of variety, it becomes evident that there is far greater scope afforded by interior architectural composition, than where novelty of design consists in nothing more than substituting one order of columns for another, or something else of that kind, without any novelty whatever in regard to arrangement, shape, and proportions in the ensemble.

Of course where a room is a simple square or parallelogram in its plan, there can be no combination; yet as soon as we proceed a step further various combinations may be obtained. Still we choose to limit ourselves in nearly every case to the simplest and first step: for if it be required to give rather more than ordinary architectural character to a room, it is usually done by putting two columns towards each end, so as to divide it into three compartments: and that being done we seem to have fairly got *au bout de notre Latin*. Let us, then, take no more than a triple arrangement of plan, and show some of the combinations that may be obtained from it, distinguishing the divisions of the plan by the terms Centre and Ends; and it will be less troublesome to ourselves, and more intelligible to our readers, if we give them in the form of a mere list. First then, in regard to plan, we have the following varieties:—

Centre and Ends all rectangular, equal in breadth, and differing only in their relative proportions.
Centre wider than Ends.
Centre narrower than Ends, or the Ends *expanded*.
Centre rectangular, Ends semicircular or curvilinear.
Centre circular or polygonal, Ends rectangular.
Centre a square or parallelogram, Ends octagonal, hexagonal or other form of polygon.

Secondly. In regard to Profile or Section:—
Centre and Ends, of uniform height and with flat ceilings.
——————— ditto arched.
Centre loftier than Ends, but with flat ceiling.
——————— and domed, or arched.
Ends loftier than Centre, and arched traversely to the latter.
——————— and domed.

Thirdly. In regard to arrangement of windows and mode of lighting:—
Centre and Ends all lighted from one side of the room.
Centre lighted from side, Ends from the extremities of the room.
Centre lighted from one side, and Ends from opposite one.
Centre lighted from side, Ends from above.
Centre lighted from above, Ends from side.
Centre and Ends all lighted from above.
Centre alone lighted, either from side or above.
Ends alone lighted, ditto.
Centre or Ends lighted not from ceiling but from windows at the sides, at a distance from the floor.

Without our extending this list any further, it will be evident that a vast number of combinations may be obtained, entirely independent of the innumerable differences arising from columns and other decoration, from dimensions and proportions, from colour and material. In fact every one of the modes above enumerated—and they are by no means all—affords as much or more scope for architectural design in other respects, than there is now by the single one which is almost invariably adhered to.

We have merely mentioned as one distinction that produced by lighting either the whole room, or one or more of its divisions from the ceiling; but then, that, too, may be effected in a variety of different ways. The light may be admitted through glazed coffers or panels (plain, again or coloured), through a dome, or through a lantern, which last admits of almost infinite variety of form and design. Lantern lights may not only vary in their plan,—be square, oblong, circular, octagonal, &c., but be ceiled above and have windows on their sides, or closed at the sides, and have the light transmitted through the ceiling, accordingly as either the design itself, or other circumstances may dictate.

It may be said—and that not unreasonably—the kind of room we have noticed, namely, one capable of being divided into compartments, is fitted only for a gallery or library of some extent. Still there are a variety of other combinations to be effected in rooms of a different class, by merely breaking their plans, yet without exactly dividing them into distinct compartments. Dining-rooms certainly admit of great architectural character being bestowed upon them, by a sideboard alcove, by which is to be understood something more than a mere shallow or *blank* recess—as it may not improperly be termed—which where there is any thing of the kind at all, is generally the *maximum* attempted, although in itself it is exceedingly little indeed.

(To be continued.)

ESTABLISHMENT FOR PROCURING MOULDS FROM MONUMENTS OF ART.

Sir,—The debate which followed Mr. Gillon's motion, cannot fail to raise the hopes of all who have the interests of taste at heart; and I hope that you will permit me, at this apparently auspicious time, to bring forward in your columns a scheme, which, although, if I may judge from the brief paragraph in a former number, does not meet your approbation in its original shape, yet if some other mode of operation can be devised, its object will, I feel convinced, have your earnest support. I allude to the formation of an establishment for procuring moulds from interesting monuments of art, and for diffusing casts from these at the cheapest possible rate, over the country.

The French have long possessed such an establishment, under the immediate patronage of government, and moulders are constantly employed in foreign countries, as well as in different parts of France, making moulds from monuments of art of every age, from the earliest times down to a late period. French moulders are to be found not only in the capital cities of Italy, but also in the ancient towns which offer so many interesting specimens of the arts of the middle ages. A few years ago, as I have already stated in a former paper, elsewhere, 11,000 dollars were spent in Florence alone, in making moulds which were afterwards conveyed to Paris. How advantageous the results of such a system! In Paris artists of every description may find specimens of sculpture from every statue and building with which they are acquainted. Architects may at a very small cost, in addition to their libraries, form museums, containing casts from portions of the buildings, the plans and elevations of which their books contain. Engravings however perfect, can convey but a faint idea of the graces of execution in architectural sculpture, and I think that the consequences of designing from these alone are sufficiently illustrated, in our cold, spiritless, and precise ornamental details.

I wish to see some such establishment as the French one in London; the subject has excited much attention in Scotland, and when I first brought it forward it was warmly taken up by many enlightened and energetic individuals; but objections were urged against it in London, although I have not been able precisely to ascertain their nature or extent. I believe that the apprehension of the creation of a monopoly, and the consequent injury to individuals who have already invested capital in casting was the strongest objection. I should like to know, how much capital is really invested in this branch of trade, and how many individuals pursue it, and how many good moulds they possess? of this I am certain that we have repeatedly been obliged to send abroad for casts, after vainly seeking them in London. It may be observed that this is not surprising, if we demand casts from works, of which it is most unlikely that casts should exist, but this has not been the case, the casts required have in most cases been such as *ought* easily to have been found in London. Your own Schools of Design are furnished from Paris, for with the exception of casts from sculptures in the British Museum, which are of the best quality, a few from foreign monuments of a very indifferent quality, and some from our national specimens of art, nothing is to be had in London.

I would here point out that there are difficulties in the way of procuring moulds from important monuments, which are insuperable to private enterprize. Government alone for instance, could procure a new mould of the Venus de Medicis. I feel convinced that although the Grand Duke will not hear of a mould from this statue of statues, he would at once accord it, to the request of a nation preferred through the proper channel, to which he owes his possession of the gem. I have no doubt that established London sculptors would willingly give fifty guineas for a first cast from a new mould of the Venus, I have known twenty-five paid in Rome for a good cast of this statue; in this point of view it seems evident that such an establishment could not prove a very costly one to the nation, for however liberal its Directors ought to be to public galleries, and however cheap casts generally should be sold to effect the good anticipated, still first casts from rare and precious works should be disposed of to individuals on different terms. There are unquestionably numberless specimens of art of the highest value and interest, casts from which, could be procured only by government influence. I mentioned the deficiency in London of moulds from important monuments, I should imagine that the chief source of profit to your casters must proceed from their employment by living sculptors, and a National Casting Establishment whose object would be wholly different, and which would supply deficiencies which it is impossible that they can ever supply, could not prove so fatal to their interest, but on the contrary, by promoting taste, and exciting a love for such objects would prove a source of increased encouragement.

If the objections to a national casting establishment are insuperable, could not some other plan be devised? The object is a great one, a commencement might be made by making moulds from the finest works in Great Britain, and then we might proceed to foreign countries: casts should be sold at as low a rate as possible, provincial galleries and schools of design should be supplied free of charge. I should hope to see every workshop a museum. The more we can accustom our lower orders to the contemplation of beautiful forms the better, and what better or cheaper means can be devised? I go further, I think it possible to erect casts in appropriate galleries of many architectural monuments, the sizes of which do not offer any insuperable difficulties. The student might measure, and delineate the Choragic monument of Lysicrates, or the arch of Titus, without going beyond London. Casts of many Gothic shrines and monuments might be put up in all the splendour of their full proportions, and where the gigantic size of any building utterly precluded such an idea, still casts of entire entablatures, capitals, and portions of shafts might be erected. What a magnificent spectacle would such a gallery offer, which contained a series of casts from early monuments down to the architecture of the last age of original invention.

I have alluded to the interest this subject has excited in Scotland, and I may truly say in England also. Learned societies, noblemen, members of Parliament, and other influential gentlemen, besides some of the most talented artists now living, have approved of this idea. I trust, Sir, that the day is not far distant when we may hope to see it adopted and followed out under some good working form, and I hope that those who have studied the subject will favour all who are interested in it with their suggestions.

I am, Sir,
Your very obedient servant,
Charles H. Wilson.

8, Northumberland Street, Edinburgh.
13th March, 1841.

[If such an establishment were confined to obtaining and moulding new works, it would, as our talented correspondent says, be most advantageous: but if, as the plan was originally proposed, it were to be a general public factory, we think that it would be of no good, but, on the contrary, productive of harm.—Edit.]

CANDIDUS'S REMARKS ON THE LECTURES OF THE PROFESSOR OF ARCHITECTURE.

Sir.—Will you allow me to offer a few remarks on the last Fasciculus of Candidus, in which he makes so free with the Professor of the Royal Academy. I would submit that he has misunderstood him on an important point in his lectures, and given him credit for a "bigotry" of which he is in nowise guilty. The Professor said nothing in disparagement of "Gothic Architecture," unless indeed his remarks on the beauty of a series of Gothic windows, on the good effect of Gothic spires in a level country, on the excellent construction and beautiful proportion of Salisbury Cathedral—on the elegant fret-work and tracery of a Gothic window, &c., may be taken in that signification. All that he said which could be interpreted as unfavourable to the style was, that he considered the revival of Gothic architecture as a fashion of the age, and like other fashions, one that passeth away.

Now if we examine the history of any age or country we shall observe a very marked correspondence between the character of the architecture, and the literature, habits and condition of the people, and that these have always progressed together. For example, the architecture of Greece clearly evinces itself to have been that of a highly refined people, possessed of a limited extent of territory, and whose principal wealth was in the hands rather of the state than of individuals, and therefore lavished almost exclusively on public buildings;—a people ambitious of bringing every thing they attempted to the utmost perfection. Their style of architecture was in all its main features adopted by the Romans, but received from them such alterations as were necessary to accommodate it to their peculiar circumstances, those of conquerors of the world; the extent, variety and magnificence of their structures were increased to a degree unknown before or since, and the exquisite delicacy of the Grecian detail in a great measure disregarded—their endeavour being to strike *every* beholder with awe—while the Greek architects sought rather to captivate the admiration of men of a refined and cultivated taste.

Taking these as examples, and I feel assured that the same reasoning may be applied to the architecture of all countries, it would seem very doubtful, whether a style which has arisen naturally from the wants and habits of one nation, could with advantage be assumed by another whose state of civilization and feeling are totally different;—and I must acknowledge that I think classical architecture harmonizes more nearly with the habits of the present age than does the Gothic. The Greeks and Romans had reached the highest point of luxury and refinement at the period at which they erected those buildings, of which the remains form models for our imitation—while on the contrary civilization has been regularly proceeding in countries where Gothic architecture was practised from that time to the present. The Romans again had communication with all parts of the known world, in almost as great a degree comparatively as we now have, while our ancestors of the middle ages had but few opportunities of enlarging the scope of their understanding, by their researches in foreign countries. The mechanical arts have since the middle ages made gigantic strides towards perfection, insomuch that many of them which have become necessary to our comfort, are found inapplicable to the peculiarities of Gothic architecture. Mullioned windows are more suitable for casements with small panes of glass, than for the large squares now in use. The introduction of slate renders the high pitched Gothic roof unnecessary, and every architect must have experienced the difficulty, nay impossibility of introducing joinery and interior finishing generally, of good Gothic character. Another great proof of the incongruity of the style with the general habits of the age, is the difficulty of persuading persons to adopt it who are not possessed of an antiquarian taste—while the expense of producing architectural effect, is with the mass the only objection to the Italian or Grecian styles.

There is still another point, and perhaps the most important of all, and that is the object of the architect where he designs in the Gothic style, compared with his object when he employs the Grecian or Roman—in the former case it is *imitation* that he aims at, in the latter *invention*. Thus the great work of excellence in a modern Gothic building is that it should be mistaken for an ancient one, the architect being governed by authority in all his details; and a departure from this rule is the principal cause of all the bad Gothic with which the eye is offended in every part of the country. This is not so much the case with Grecian or Roman—from the nature of the style a greater regularity is necessary, certain proportions have been determined on for the principal members, and as long as these are preserved, there is no restriction on any novelty that may be produced in accordance with them. This last objection applies as much to ecclesiastical as to domestic architecture, which I admit is not the case with those first stated.

If these views are correct, it is very possible to discourage, with the Professor, the indiscriminate revival of the architecture of the middle ages, without in the slightest degree adopting the prejudices of Evelyn, in considering it "monkish and gloomy, and devoid of all harmony and proportion," or those of Morris,* who looked upon the "boasted piles of Salisbury and Westminster, &c., only as so many monuments of wanton and tasteless expenditure;" or those of Hamilton,† who looks upon it as the offspring of the dark ages of Gothic barbarism.

I am, Sir, &c.
S. L.

March 13, 1841.

HARBOURS ON THE SOUTH EASTERN COAST.

Sir—As you have done me the favour to insert several communications of mine relative to bars and other nautical matters, I take leave to request that you will give publicity in your next Journal to the following observations, suggested by the motion of the hon. member for Dover, E. A. Rice, Esq., for a select committee of the House of Commons on the state of the harbours on the S. E. coast, to which the report of the commission of 1840, on the state of the harbours on that coast, should be referred. This motion was negatived by a majority of 64 in a house of 140 members.

The mover and seconder of the motion re-stated what has been often urged on the public by your Journal, *i. e.* that on the entire extent of coast from the Thames to the Isle of Wight, there is not a harbour of refuge either as a port of rendezvous for the navy, or for the protection of our merchant vessels in adverse winds, and stormy

* In a small work on the proportions to be observed in architecture. By R. Morris, 1739.

† Letter to the Earl of Elgin on the new Houses of Parliament. By Wm. Hamilton, architect, 1836.

weather. This, too, is on a part of the coast at a short distance from that of France, the government of which has caused essential improvements to be effected in various ports opposite to the English shores, and to which their steamers can resort in time of war, much to the annoyance and injury of our commercial marine, while our shores have no such port or protection.

That part of the coast and Channel here referred to, is navigated by a greater number of valuable ships and cargoes than any other channel in the world, except the N.E. coast; consequently the loss of valuable property (£5,000,000 *annually*, and the more valuable human lives, 100,) is in the proportion to the number of vessels passing up and down the British Channel, losses which are occasioned by the lack of harbours of refuge, (as a committee of the House of Commons have determined,) and yet the legislature of the greatest of all naval and maritime commercial nations has negatived a proposition of such vital importance to the safety of the navy, and the protection of our merchant vessels and their crews; an object of primary and vital importance.

The Right Honourable the Chancellor of the Exchequer was pleased to observe, in his opposition to the motion, "as regarding the commission he did not hesitate to say, that from the character of those composing it, and their fitness for the task assigned to them, no committee of the House of Commons could have the same weight with the public." But the public might have had much more confidence in the opinions which would have been elicited from scientific and practical men, whom such a committee would examine. The right hon. gentleman subsequently said, "With respect to the report of the commissioners, one part of it was somewhat doubtful;" (a *most important* part;) "Three different plans were proposed, and the expences were estimated at £6,000,000: now he *doubted* whether means could not be adopted for effecting the purpose at a much less expense."

In a petition which I had presented to the House of Commons in the session of 1840, I endeavoured to show that the sites selected, and the plans recommended by the commissioners for the construction of three refuge harbours, could not obtain the proposed advantages. *i.e.*, eligible harbours of refuge, with safe ingress and egress *at all times*; and, that much beneficial improvement might be effected at Dover, and that all that could be obtained in that vicinity was attainable at a cost of £3,000,000.

The estimated cost of constructing a harbour at the North Foreland, at Dover, and at Beachy Head, as contained in the report referred to, emanated from the engineers who were of the commission: the accuracy of these estimates is doubted by the Chancellor of the Exchequer. If those gentlemen were in error on that part of the case which immediately belongs to their department, no correct information ought to be expected from them on the nautical part of the subject, *i.e.* an eligible site for construction, and the best method of forming the entrance and departing passages.

It is essential to remark here, that the harbours of Lowestoft, Dover, Hartlepool, &c., demonstrate two important facts, that the application of sluicing or scouring water is a most fallacious principle to pursue, either in constructing or in improving harbours, and that the impetus of the wave and the influence of the wind and tides, are not to be controlled by mathematical calculations; harbours and bars are affairs exclusively to be managed by men of long nautical experience, possessing local information; but other parties being consulted give cause to the many failures in attempts to improve and construct harbours, and the immense loss of money in such attempts: *e. g.* Lowestoft, an entire failure, with the loss of an expenditure of about £100,000, now offered for sale by her Majesty's loan commissioners for £17,000. Dover, after a large expenditure—bar accumulating. Hartlepool—sluices injurious, and therefore discontinued.

The competency of the other gentlemen of the committee is not proved by their previous practical knowledge of the S. E. coast, for if they have at any time navigated that part of our seas, it was, no doubt, under the direction of pilots. The report bears testimony that to the places and principles for constructing harbours on the S. E. coast, as recommended by them, there is an insuperable objection.

Regretting that a subject of so much importance should have been so long neglected and again procrastinated, a subject brought before a committee of the House of Commons in 1826 and 1827, and again in 1836,

I remain, Sir,
Your's, &c.,
HENRY BARRETT.

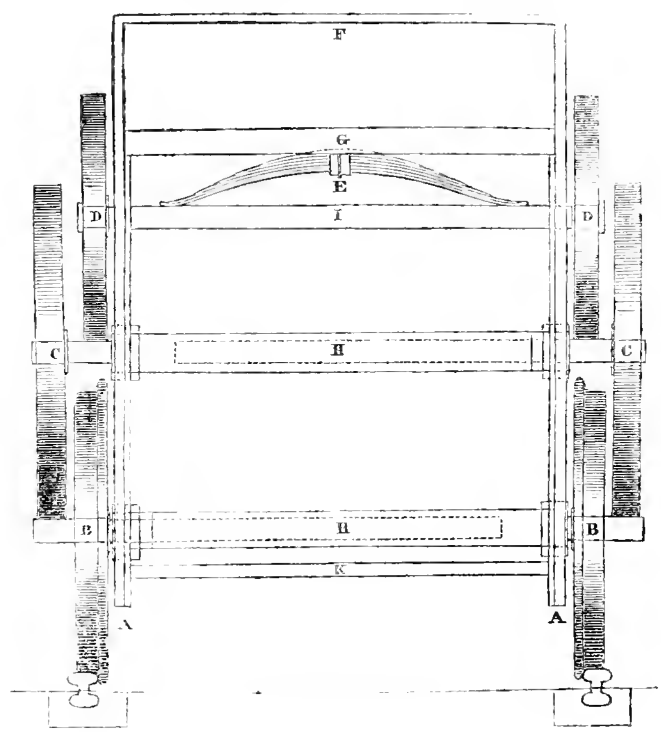
23rd March, 1841.

COLES'S PATENT SOCKET AXLETREE.

Mr. Coles the inventor of the Anti-friction Wheel Carriage described in the Journal vol. I, p. 107, has lately taken out a patent for an improvement in axle-trees for railway carriages, whereby one of a pair of wheels may turn without the other. It is well known that there is great friction between the flange of a wheel and the rails when working round curves, particularly if they be sharp ones; to obviate this evil, Mr. Coles has invented a socket axle-tree as described in the annexed engraving, whereby it will be perceived that either wheel may turn whilst the other is standing still, at the same time the axle possessing all the rigidity of one that is fixed to both wheels; by this arrangement the outer or off wheel when working round a curve can make a larger number of revolutions than the inner wheel, and when running on a straight line they will both make the same number of revolutions.

The axle-tree is thus formed, a hollow axle is carefully turned with a socket or tube nearly the whole length of the width of the carriage, into which is fitted the axle of the other wheel, this axle is carefully turned with a shoulder at each end three or four inches wide, the small vacuity between the shoulders, and also between the outer and inner axle-trees is filled with oil, which lubricates the rubbing surfaces of the axle.

Transverse section of a carriage showing the frame, axles and wheels, for working on common rails or roads.



A A, the frame; B B, the ground wheels, which are anti-friction; C C, the large anti-friction wheels; D D, working or friction wheels; E, the spring; F, top of carriage; G, upper cross stay; H H, axles working in sockets; K, the bottom cross stay.

Government Museum of Economic Geology.—The arrangements for the opening of this new institution are progressing but slowly, and nothing has yet been decided as to when it will be thrown open to the public. It occupies the two corner houses, Nos. 5 and 6 in Craig's-court, which have undergone extensive alterations for the purpose. In addition to several rooms which will be devoted to the arrangements of the cases and cabinets composing the museum, there is a well-stored laboratory for instruction in practical analysis upon the ground floor. A large and prominent part of the collection in the museum is the extensive series of specimens of stone obtained by the commission for investigating the best material for building the new Houses of Parliament. The depository for mining records, forming another branch of the establishment, is already rich in statistical annals and details connected with the mining industry of the kingdom. Each department will be open to the public on three or more days in the week under certain restrictions.—*Morning Post.*

RAILWAY STATISTICS.

[The following Tables have been compiled from Mr. Whishaw's work on the Railways of Great Britain.]

Table A gives the total lengths of railways, from which it appears that of 58 railways enumerated, 1699½ miles in length, 31 (measuring 319¾ miles) are under twenty miles in length, suggesting a great waste of capital in the management.

Table B gives the lengths of 58 railways distributed as single and double lines of railway, by which it appears that not more than a sixth are single lines of railway.

Table C shows the number of miles of single and double railways laid down upon each gauge for 1756 miles of railway, with the total of miles of single railway laid down on each system, giving a total of 3217¾ miles of single railway, of which 2544 are laid down on the common gauge, and 427 miles on the broad gauge.

Table D shows the number of miles of single and double railway, the stated number of miles of railway, and the number of miles of single railway laid down with each of seven principal forms of rails, according to the classification of Mr. Whishaw.

Table E shows for 2271½ miles of single railway, the number of miles of single and double railway, the total number of miles of railway, and the number of miles of single railway, of each kind of rail, with the total weight in tons. It thus appears that rails of nearly 30 different weights are in use.

Table F shows for 2271½ miles of single railway, the number of miles of single railway of each description of rails, with the weight in tons, and the proportion per cent. of each class. From this it seems that about a quarter or 516¾ miles of single railway have rails under 50 lb. weight. The total weight of rails for 2271½ miles of single railway is 204,412 tons, and if we take the remaining portion of railways at the same average, we shall have a total of 309,604 tons of iron consumed as rails.

Table B.

Table of Lengths of Railway.

	Single.	Miles.	Double	Miles.	Total.	Miles.
5 miles and under	2	7¾	3	8¾	5	16½
10 ,,	5	37¼	8	58	13	95¼
15 ,,	3	37½	2	27	5	64½
26 ,,	3	48½	5	95	8	143½
25 ,,	1	24	3	66¾	4	90¾
30 ,,	—	—	2	55¾	2	55¾
35 ,,	1	32½	2	71	3	103½
40 ,,	1	36	3	116¾	4	152¾
45 ,,	—	—	2	87	2	87
50 ,,	—	—	2	96	2	96
60 ,,	—	—	2	110¼	2	110¼
70 ,,	1	61¾	1	69½	2	131¼
80 ,,	—	—	3	225	3	225
90 ,,	—	—	—	—	—	—
100 ,,	—	—	1	97½	1	97½
110 ,,	—	—	—	—	—	—
120 ,,	—	—	2	230	2	230
	17	285¼	41	1414¼	58	1699½

Table C.

Table of Miles of Gauge.

	Single.	Double.	Total Miles of Railway.	Total Miles of Rails.
4 feet 6	21½	20½	42	62½
4 feet 6½	10¾	—	10¾	10¾
4 feet 8½	200½	963¾	1164¼	2138
4 feet 8¾	—	91	91	182
4 feet 9	—	112	112	224
5 feet	—	51	51	102
5 feet 6	35½	—	35½	35½
6 feet 2	36	—	36	36
7 feet	—	213½	213½	427
	304¼	1451¾	1756	3217¾

Table A.

Table of Lengths of Railway.

	No.	Miles.
5 miles and under	5	16½
10 ,, ...	13	95¼
20 ,, ...	13	208
50 ,, ...	19	661¾
100 ,, ...	7	488
100 and upwards	2	230
	58	1699½

Table D.

Table of Shapes of Rails.

	Miles Single.	Miles Double.	Miles of Railway.	Miles of Single.
Single Parallel.........	60¼	253¼	313½	566¾
Parallel	107¼	209	316¼	525¼
Double Parallel	18¾	381¾	400½	782¼
Shallow Parallel	—	52½	52½	105
Fishbellied	82	17½	99½	117
Bridge Rail	39¼	138¾	276	699¾
Broad based T........	—	56	56	112

Table E.

Table of Miles of Rails.

Lbs. per yard.	Miles Single.	Miles Double.	Miles of Railway.	Miles of Rails.	Tons Weight.
20	3	—	3	3	82
28	8	12¼	20¼	32½	242
35	32½	20	52½	72½	3980
40	4¾	—	4¾	4¾	298
42	42¾	4¼	47	51¼	3366
43	3¼	—	3	3¼	218
44	—	58¾	58¾	117½	8142
45	32½	26	58½	84½	5966
48	29½	—	29½	29½	2230
50	61¾	29	90¾	119¾	9420
53	36	—	36	36	2974
54¼	—	27	27	54	2580
54½	—	6¾	6¾	13½	1154
55	30½	38¾	69½	107	9234
56	—	175½	175¾	351	30958
57	—	38¾	38¾	77½	6956
60	—	36¼	36¼	72½	6828
62	—	162¾	162¾	325½	32600
63	3¼	47¼	50½	97½	9642
64	—	38	38	76	7660
65	3½	119¾	123¼	242½	24686
68	4	—	4	4	428
70	—	9	9	18	1980
73	—	36¾	36¾	73½	8408
76	—	42½	42½	85	10114
77	—	57¾	57¾	115½	13738
84	4	—	4	4	528

Table F.

Table of Miles of Rails and Weight in Tons.

Lbs. per Yard.	Miles of Rails.	Proportion per Cent.
20	3	82
30	32½	242
40	77	4278
50	405¾	29342
60	711½	62684
70	763½	76996
80	274	32250
90	4	528
	2271½	206,402

REMARKS ON THE CENTRAL FORCES OF BODIES REVOLVING ABOUT FIXED AXES.

By Joseph Martin, M.D.

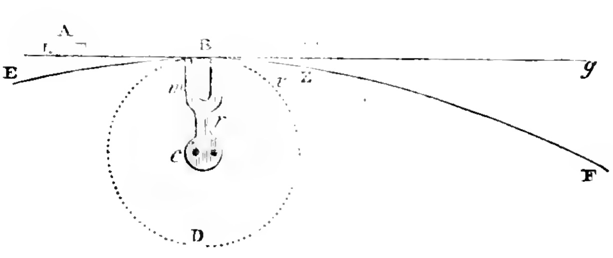
(From Silliman's American Journal.)

The theory of curvilinear motion may justly be considered one of the most important and interesting subjects connected with the physical sciences. It explains the motions of the heavenly bodies, and, by unfolding some of the grand phenomena of nature, makes them applicable to the most important and useful purposes of life. It has accordingly engaged the attention of the greatest philosophers for centuries, who have, by means of the most searching analyses, not only pointed out the slightest irregularities of those bodies which compose the great planetary system, but have discovered the causes of the seeming aberrations, and given satisfactory explanations of them. And yet it would seem that the most simple case of "central forces," the rotation of a heavy body about a fixed axis, has been in some measure neglected, or at least, treated as a subject of too little importance, either in a theoretical or practical point of view, to deserve more than a passing notice.

To explain the motions of the heavenly bodies it has been found necessary, by means of mathematical reasoning, to determine the ratio of attraction and original impulse, or projectile force, and to show the effects of their separate and combined operation. In this way the part that each of the three forces, the projectile and the central, perform in producing and preserving the motion of a planet in its orbit, is clearly defined; as well as the results that would follow if either of the last should cease to act. But the ratio of the forces which act upon a body made to revolve about a fixed axis, and the nature and extent of their separate or combined action, have not been distinctly shown. In other words, it is believed that the relative proportions of the moving power, and the forces that it produces directly and indirectly—the manner in which the central forces are excited—and the combined operation of all the forces upon a body whilst revolving and when projected, have not been satisfactorily explained.

It is not intended, however, at present to enter into an investigation of the subject upon principles purely dynamical, but the object of these remarks is to show by mathematical reasoning, founded upon experiment and familiar examples, that the power employed to revolve a body about a fixed axis is wholly expended in giving velocity to that body in the direction of the circle, and that, consequently, the central forces must be excited in obedience to a law of nature; and, in the second place, that the moving and excited forces act in conformity with the principles of "the composition of forces."

Fig. 1.



If the bar of soft iron m, fig. 1, be prepared as a horse-shoe magnet and secured in a proper manner to the rod r, working horizontally on an axle at c, it may be connected at pleasure with a galvanic battery, by means of its wires and the usual arrangements of cups containing quicksilver, at the centre. The iron bar A, of a suitable size and description, moving with a given uniform velocity along the straight line Ag, would be attracted at B by the magnet, if it were connected at that moment with the galvanic battery, and would be made to move in the curve Br of the circle BD, but in virtue of its inertia it would, in the absence of friction and atmospheric resistance, continue to move in that circle with the same uniform velocity. For the deflecting force being independent of the projectile force, and acting at all times in the direction of the radii of the circle, it cannot in any respect increase nor diminish the original velocity of the bar. And for the same reasons the force with which the bar is moving in the circle can have no influence upon the deflecting force. But a body moving in a curve or circle is always found to be acted upon by a third force, which is opposite and equal to the deflecting or centripetal force; and as there cannot be an effect without a cause, this third force must either be derived from one of those mentioned above, or their resultant—or from some other source. Supposing the circle BD, in which the bar moves, to be one foot in diameter, and the velocity of the bar to be 25·14 feet per second, or at the rate of eight entire revolutions in a second, its centrifogal velocity would be $= \frac{v^2}{2r} = \frac{25{\cdot}14^2}{1} = 632$ feet per second, and its centrifugal force $= 39$ lb. its weight being one pound, v representing the velocity in the circle, and r its radius; for if a be the weight of the bar, g equal to $32\frac{1}{12}$ feet, and x the force required, then $r : \frac{v^2}{g} :: a : \frac{v^2 a}{gr} = x = \frac{25{\cdot}14^2}{16} = 39$ lb.* But the force in the circle $= \frac{25{\cdot}14}{16} = 1{\cdot}55$ lb. only, consequently the centrifugal force could not have been caused by the projectile force. And it is evident that it cannot be a part of the magnetic force, for it acts in a directly opposite direction; and it is equally evident that it cannot be the resultant of the other two forces, for then its direction would be to some point within the circle. The pressure from the centre of thirty-nine pounds must therefore have originated in some other way.

Such are the facts when the deflection from a straight line is caused by a centripetal force directed to a fixed centre of rotation, and the projectile or moving force is applied before the body is constrained to move in a circle. We will now stop the revolving rod r, leaving the bar A attached to m, by the magnetic force. If by means of a winch the same number of revolutions in a second be given to the bar that it had in the first experiment, the centripetal or magnetic force will perform the part of cohesion, and the circumstances in every other respect will be the same that would attend such a rotation if the bar were welded to m. Does the moving power, applied in this manner, directly produce the central force or immediately impart it to the moving body? or, in other words, is centrifogal force a part of the force employed to revolve the body? Without attempting to prove the negative of this question by minute mathematical investigations, which will be avoided as much as possible on this occasion, I will show by a reference to the familiar examples of the common sling and fly-wheel, that in a revolving body centrifugal force, whatever be its source, is much greater than the power necessary to give rotation to that body, and that it cannot therefore be directly caused by the moving power,—and then explain how it may be proved by a simple experiment.

It has been stated above that writers on dynamics have not clearly defined the operation of the laws of curvilinear motion on bodies revolving about fixed axes. One only of the many instances in which erroneous views are given by popular writers in noticing the subject of central forces, will be mentioned. In the Library of Useful Knowledge [London edition] a writer, after enumerating some of the wonderful effects produced by *accumulating force in the circumference* of a fly-wheel, remarks: "the same principle explains the force with which a stone may be projected from a sling. The thong is swung several times round by the force of the arm until a considerable portion of force is accumulated and then it (the stone) is projected with all the collected force.† By observing the facts we may discover how all this accumulation of force is produced by the strength of the arm. A stone, S, fig. 2, weighing one pound, secured to the end of a string rather less than two feet long, may be whirled in a circle of four feet diameter at the rate of two entire revolutions in a second. It is done by turning the hand in a small circle AB, about a moving axis of rotation. The velocity in the large circle $= 12{\cdot}57 \times 2 = 25{\cdot}14$ feet per second; and, as shown above, if S represent the weight of the stone, v its velocity, r the radius of the circle and x the centrifugal velocity, then $r : \frac{v^2}{64} :: S : \frac{v^2 s}{32r} = x = \frac{25{\cdot}14^2}{32 \times 2} = 9{\cdot}87$ pounds. The velocity in the circle being 25·14 its force in that direction is equal to 1·58 lb. ‡ and if we add 1·42 lb. for the weight of the stone and atmospheric resistance, which is more than sufficient, we have three pounds as the force with which it is impelled in the circle ST. To enable him to move the stone in the circle the operator has to *resist a force nearly equal to ten pounds, which urges his hand from the centre at every instant*

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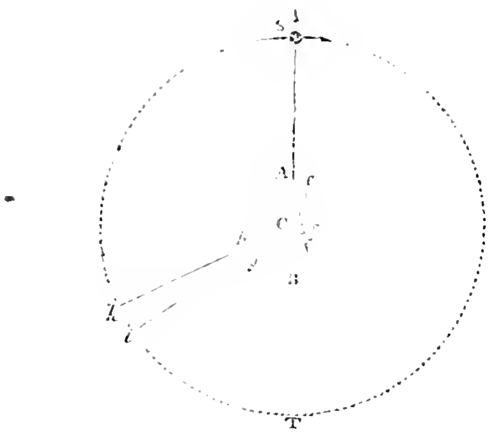
* Hutton's Mathematical Dictionary, and Gregory's Mechanics.

† Vol. I. p. 51. Art. Mechanics.

‡ Cavallo's Philosophy p. [illegible]

Fig. 2.

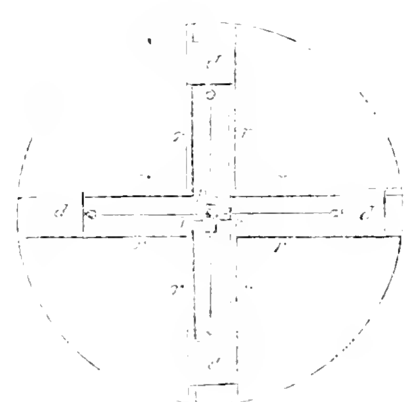


of time. He must therefore exert his strength at A in the direction of the resultant of the two forces with an effort which is equal in amount to their mechanical equivalent. If we make A*s* and A*c* in length proportionate to the forces 3 and 10 respectively, then the diagonal A*f* of the parallelogram A*sfc*, will show the direction in which he draws at the string, and $\sqrt{10^2 + 3^2} = 10{\cdot}44$ lb. will be the amount of force necessary to give the required velocity; of which, as shown above, two-thirds are expended in retaining the stone in the circle. Now it would be about as easy to show that a man can draw at a flexible cord secured to a stationary object with a force equal to 10 pounds, and at the same time press against that object, *by means of the cord*, with a force equal to six pounds, as to prove that the centrifugal force in this case is the immediate effect of the moving power. The man moves his hand in a small circle and pulls at a stone, nearly in the direction of the string to which it is attached, with a force equal to six times the weight of the stone, and yet, according to the popular belief, he not only imparts directly to it all the force with which it is projected, but dashes it off at right angles to the thong, as if it were moved at the end of a lever.

The thong of the sling, from what is said above, may be considered as in the place of an inflexible rod, the hand resisting the pressure that would act as a strain upon an axle at *c*; and if such a rod had a handle at A, the same effect might be produced. But it would cause great friction and strain upon the axle, and to obviate those difficulties, we will consider the circle ST as passing through the centre of the rim of a fly-wheel connected by arms with the small circle AB, representing a nave working on an axle at *c*. If the rim be supposed to weigh 150 lb. it might easily be revolved at the rate of two entire revolutions in a second by a handle at A, which is four inches from the centre, or so considered for illustration. When the winch A is moved about the axis, the force may be considered as acting by repeated slight impulses, as if it were applied at right angles to the radius of the circle, at each instant of time along the side of a polygon with an infinite number of sides, drawn within the circle. If the sides of the polygon be one hundred in number, they would be one fourth of an inch long, and then one and a half inches in the larger circle ST, will be the length of each side of a polygon along which the centre particles of the rim may be supposed to move. As the proportion of the circle ST is to AB as six is to unit, a moving power acting on the latter at the winch A, with a given force, through *g*, *h*, one fourth of an inch, will move the rim through *i*, *k*, equal to six times that space, with one sixth of the force applied; but as *the moment of rotation is equal to force multiplied by leverage*, the whole amount of force upon the rim through that space must be exactly equal to the power applied through the fourth of an inch upon A. And so of each side of the two polygons respectively. But they are considered infinitely small and ultimately become parts of the two circles; the power therefore must be applied in a circle, and the particles of the rim must be propelled in circles with a force exactly equal to that power. Consequently, the moving power, applied to a fly-wheel or to any other revolving body, cannot be expended in pressing the particles of such bodies from the centres nor in the direction of tangents to the circles in which they revolve. And this is evident from the fact, that such moving bodies cannot give out nor impart, in any manner whatever, more force than is applied to revolve them. And *that force is not only equal* to the power applied, but it is always returned in the circle in which the body moves, *and in a direction contrary to that in which it was received.* "If a wheel spinning on its axis with a certain velocity be stopped by a hand *seizing one of the spokes*, the effort which accomplishes this is exactly the same, as, had the wheel been previously at rest, would have put it in motion in the opposite direction with the same velocity."* The force applied to the winch, in the case above, was wholly expended in giving velocity to the rim, with the slight exceptions mentioned. Consequently, whatever other forces may have operated on the rim whilst revolving must have originated in some other way. And yet those extraneous forces would amount to 1480 lb., as shown by the above formula, the rim weighing 150 lb. and being revolved at the rate of two entire revolutions in a second. No part of this force could be communicated to the arm of a man who would stop such a wheel by seizing one of the spokes, because *each particle* of the rim is acted upon by the central forces, which are always opposite and equal, in the direction of the radius of the circle *at that point;* and it has just been shown that the moment of rotation of each particle is equal to the moment of rotation of the power that impels it, but "as the direction of the central forces is in that of the radius, their moment of rotation is equal to nothing."† Consequently the centrifugal force cannot act upon the hand that stops the wheel. If, indeed, the centrifugal force were increased to sixteen times the above amount, the result would be the same. By giving the wheel eight revolutions in a second we would have the central force $= 1480 \times 16 = 23{,}680$ lb. and the force in the circle would be $= \dfrac{12{\cdot}57 \times 8 \times 150}{16} = 925$ lb. Here the centrifugal force is twenty times greater than the force in the circle, and yet as the central force would act in the direction of the radii, its moment of rotation would be $= 0$. Or, what is more strictly the fact, the central force acts by pressure, and a resultant from that pressure and the force in the circle is the consequence, but so long as resistance from cohesion continues, neither motion nor pressure can be imparted to another body by the central force. These are the obvious reasons why no greater force could be communicated by the rim than the 925 lb., which it only possesses as a mass of matter moving in a circle.

The following experiment may be considered as a practical illustration of the theoretical views given above. A whirling table may be made of any convenient size, we will say, for the present occasion, rather more than four feet in diameter, to revolve horizontally on friction rollers placed near the centre; the axle being a hollow cylinder, through which four cords pass to the floor to be connected with a tin tube for containing shot or some other weight. The cords are brought over the pulleys *p, p, p, p*, fig. 3, at the centre, and secured to the dishes *d, d, d, d*, weighing one pound each, and moving, with very

Fig. 3.



little friction, on little wheels adapted to the strips or rails *r, r, r, r*. By connecting this table with wheel-work, having bands or teeth acting on the hollow cylinder as a spindle, by means of a weight or power

* Kater and Lardner on Mechanics, p. 24.
† Renwick's Mathematics. Art. Composition of Forces.

suspended by a rope wound round an axle, and moving *very slowly*, a certain number of revolutions in a minute will be given to it by the power, in passing through a given space, and the four dishes will raise, by their centrifugal force, a weight in the tube below, proportionate to the velocity and their distance from the centre. If the *moving power be then doubled*, with a slight addition to overcome the additional friction and atmospheric resistance, it will be found, *that in moving through an equal space in the same time*, it will give twice the former velocity, and the dishes, at the same distance from the centre, will raise in the tube below, in an equal time, *quadruple the weight first raised*. Then by loading the dishes and increasing or diminishing the velocity, and varying the distances of the dishes from the centre, a variety of experiments may be made, and weights may be raised, with corresponding distances and velocities proportionate to those given above.

By observing the manner of performing the experiments with the magnetized bar, it will be seen that a centrifugal force is excited, INDEPENDENTLY OF THE PROJECTILE FORCE, equal to the supposed power of the magnet, and we have shown that the same effects would follow without the use of the magnet. And that the impelling or moving power performs no other part in producing the complex effects attendant upon rotation, than simply to move the particles of a mass of matter in circles about a fixed axis, may be clearly shown by the theory of curvilinear motion, which those experiments were designed to illustrate. But without attempting to prove this at present, by abstract mathematical reasoning, the nature of deflection and the extent of its operation in exciting the central forces, may be explained by a reference to the action of electro-magnetism as shown in Fig. 4.

The bar A, when attached by the magnet, being supposed to revolve in a circle of one foot in diameter, at the rate of eight revolutions in a second, or 25·14 feet, to determine the amount of deflection in any unit of time, say one fiftieth of a second, the whole space through which it moves in a second may be divided into fifty parts, which will give six inches for each unit of time. If this space be measured on the tangent from B to *x*, and on the circumference of the circle to *r*, the deflection for the one fiftieth of a second would be equal to the square of B*r*, divided by BD, or the diameter. For by dynamics, "if a body revolve uniformly in a circle, the space through which it would move by the action of the centripetal force alone in any unit of time, such as a second, will be equal to the square of the arch described in the same unit divided by the diameter or twice the radius."* And the deflection of the bar in the $\frac{1}{50}$ of a second $= \frac{Br^2}{2Bc} = \frac{6^2}{2r} = 3$ inches. That is, the deflection from the tangent B*g*, during the time that the bar would have passed over six inches in that line, is three inches; and the deflection corresponding with the space B*g*, which is equal to two feet, and through which the bar would have passed in the $\frac{1}{12}$ of a second, would be $= \frac{2^2}{2r} = 4$ feet, and so of any other space.

Now to show that the amount of this deflection or centrifugal force depends upon the curve in which the bar is moved in a given time, and not upon the moving power, or projectile force, we will cause the same bar, moving with an equal uniform velocity, to be attracted in a similar manner by the magnet *m*, attached to an arm revolving in a circle of eight feet in diameter, and let EF be an arch of that circle, touching the straight line A*g* at B. As the velocity of the bar and the circumference of the circle are equal, the bar, after being attracted by the magnet at B, would move on with the same uniform velocity and perform one entire revolution in a second, friction and the resistance of the atmosphere being considered equal to nothing. And its deflection from the straight line, or its centripetal force for $\frac{1}{50}$ of a second, would be equal to the square of the arch B*z*, which is six inches, divided by the diameter of the circle, that is $= \frac{6^2}{8} = \cdot375 = \frac{3}{8}$ of an inch, or only one eighth of the deflection caused by the smaller wheel; and in the same ratio for any other spaces through which the bar would have passed whilst moving through equal spaces in the circle. And hence it is that the central forces are inversely as the diameters of the circles in which a body is made to move with a given velocity. The increment of deflection for an entire second being $= \frac{25\cdot14^2}{1} = 632$ feet per second in the smaller wheel, and in the larger one $= \frac{25\cdot14^2}{8} = 79$ feet per second only; and yet the bar has precisely the same velocity, and consequently the same force in the latter that it had in the former. Therefore, aside from friction, it would, if welded to *m*, require no more force to revolve it in the former than in the latter case.

For the same reasons, with a given velocity for the particles of the rims, the smaller a fly-wheel is, the greater will be the amount of centrifugal force, other things being equal. This will appear obvious upon inspecting the figure; for it will be seen that a particle of iron at *r* in the rim of a small wheel would be deflected from the straight line eight times as many inches in a given unit of time as a particle would be at the point *z* of the large wheel. The measure of the deflection from that line must therefore be the measure of the centrifugal force for any instant of time; and consequently the aggregate amount will be proportionate to the curve in which the body moves. This deflection takes place when a body is moved in a curved line, and the tendency to resist it and move in a straight line is excited in such a mass of matter in obedience to the important law of inertia, with as much certainty as electricity would result from the action of sulphuric acid upon two contiguous plates of zinc and copper. *Centrifugal force may therefore with propriety be considered a physical agent, which is called into action, by an inscrutable law of nature, whenever matter is made to move in a curve;*—which ought to be no more a subject of surprise, than that magnetic force should be excited in a bar of iron by certain chemical operations, the precise nature of which is as little understood as that of inertia.

The centrifugal principle has been employed as a projectile force from the earliest ages. It would be interesting to notice the extent to which it was used in ancient wars; and particularly to point out, as might be done even with the feeble lights afforded us, how much Archimedes was indebted to the central forces for the destructive effects of his engines, which I believe to have been no fabled nor imaginary productions of genius.

As I shall here come in conflict with some generally received opinions, I will give a short extract from Professor Renwick's Elements of Mechanics. Not that he differs from other writers on this subject, but I find that the extract will be useful in explaining what is to follow. "The simplest case of central force is where a body connected with a fixed point by an inflexible straight line is impelled by a projectile force at right angles to that line. The latter force would have impressed upon the body a motion with a uniform velocity. The body, then, in consequence of its connexion with a fixed point, describes a circle of which that point is the centre. If the connexion were to cease at any point in the curve, the deflecting force would cease to act, and the body would go in a straight line whose direction would be a tangent to the curve. The force acting at any point in the curve must therefore be decomposed into two, one of which is in the direction of the curve, the other in that of the radius."†

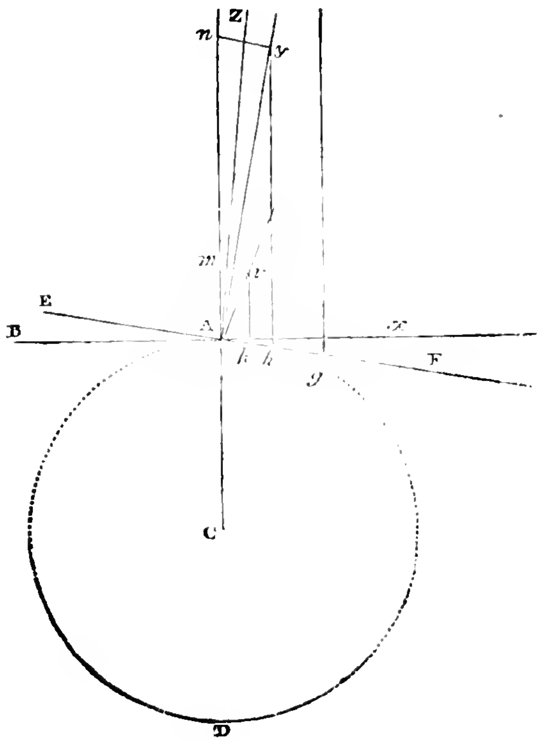
If a ball at A, Fig. 4, weighing one pound, and attached to an inflexible rod AC, two feet long, be impelled by a projectile force or moving power at the rate of two entire revolutions in a second, or $25\frac{14}{100}$ feet per second, it will have a centrifugal velocity equal to 157·76 feet per second.‡ Those two velocities, then, equivalent to the forces 1·58 lb. and 9·87 lb. respectively, constitute the aggregate amount of force acting on the body at any point of the curve or circle; the former acting in the direction of the curve, and the latter in that of the radius—one caused by the motion of the particles of matter, the other excited by a cause producing pressure, resisted by cohesion. Now, according to the fundamental principles of mechanics, "the same cause acting upon a body will either produce motion or pressure, according as the body is free or restrained." And, "if two forces act upon the same point of a body in different directions, a single force may be assigned which, acting on that point, will produce the same results as the united effects of the other two." Here we have two forces acting on each particle of the revolving body, but they are resisted by cohesion, therefore when cohesion ceases to act, the effect of the two forces must be, according to the theorem of the composition of forces, to impel it in the direction of their resultant, and with an amount of force equal to their mechanical equivalent; and experiment shows the correctness of the theory. If an ounce ball of lead, with a small hole drilled through it, be firmly secured by a catgut string close to the perimeter of a fly-wheel, or any other wheel that can be rapidly revolved, it may be discharged from the vertical point of the circumference, whilst the wheel is revolving, by interposing a sharp knife well fixed in a slide. When the velocity necessary to project the ball horizontally at a given short distance has been ascertained, then by increasing the velocity and taking care to discharge the ball from the same point of the circle, and at an equal distance from the centre of the wheel, its elevation will be found to increase with the increased

* Brewster's New Edinburgh Encyclopædia, Art. Dynamics.

† Page 62.

‡ Cavallo, p. 66.

Fig. 4.



projectile force. And the experiment may be varied by having a number of balls prepared of the same weight, and varying the velocities and the distances from the centre. The effects of gravity, however, and the difficulty of representing by a straight line what may be considered the direction of the circle, have prevented me from determining *geometrically the direction* of the projectile, although in practice it may easily be ascertained.

If the ball be discharged from the point A with one revolution in a second, its velocity in the circle would be 12·57 feet per second, and its centrifugal velocity would be $= \frac{v^2}{2r} = \frac{12{\cdot}57^2}{4} = 39{\cdot}44$ feet per second, and the initial projectile velocity would be $= \sqrt{12{\cdot}57^2 + 39{\cdot}14^2}$ $= 41{\cdot}40$ feet per second, disregarding for the present atmospheric resistance. And if, in the way of illustration, AF be considered as the direction of the force in the circle AD, the sides A*k* and A*m*, of the parallelogram A*mrk*, being made proportionate to the two velocities 12·57 and 39·50 respectively, the diagonal A*r* of the parallelogram will represent in direction and proportional amount the velocity 41·15 or initial projectile velocity. If a billiard-ball, moving upon a table with a velocity equal to 12½ feet per second in the direction EF, were to receive at A an impulse in the direction of *cn*, which alone would cause it to move with a velocity equal to 39½ feet per second, no other direction and velocity could be assigned to it, than that designated by the diagonal A*r* of the parallelogram. The revolving ball is supposed to move in the direction A*k* with the velocity of 12·57 feet per second, represented by that side of the parallelogram, and at the same time to be acted upon by a force which would cause it to move with a velocity equal to 39½ feet per second, in the direction of the side A*m*, which indicates that velocity, consequently *no other direction nor amount can be assigned to it, when projected, than the diagonal* A*r of the parallelogram* A*mrk*. If the velocity of the ball be doubled, the centrifugal velocity increasing as the square of the increased velocity in the circle, it would be $= 39{\cdot}14 \times 4 = 157{\cdot}76$ feet per second, and the initial projectile velocity would be $= \sqrt{25{\cdot}14^2 + 158^2}$ $= 160$ feet per second; and the two first would be represented by the sides A*h* and A*n*, respectively, of the parallelogram A*nyh*, and the diagonal A*y* would indicate the direction and relative proportion of the initial projectile velocity. With four revolutions in a second, the initial projectile velocity would be 635 feet per second, in the direction of the line A*z*. At least such would be the directions for those three velocities *at the instant the ball leaves the point from which it may be discharged.* But with such low velocities a pound ball would not indicate those directions by its path, for the reasons given above. *With very high increasing velocities*, however, the experimenter will find that a small leaden ball will move in directions approaching that of the radius, as shown in the diagram. In repeated experiments made with a machine revolving vertically, and having a tube placed in the direction of a tangent to the circle in which leaden balls were revolved, it was found that with very high velocities they were forced through the tube with difficulty, and a portion of each was removed by the friction, and the upper part of the tube, on the inside, was worn smooth. But with much lower velocities the balls passed through the tube without any apparent friction.

In performing the first experiment, the bar, (A, Fig. 1,) moving with uniform velocity in every part of the circle BD, has the same centrifugal force at *r* that it would have after revolving for a minute or more; for the amount of that force depends upon the curvature and the circular velocity, and consequently was excited to the amount of thirty-nine pounds instantaneoosly, and if it had been discharged at three inches from B it would have been projected with that force. If this were not the case with bodies moving in space, supposed to be thus deflected, they would fall to the centre of attraction. Now as this is the fact, the *tangent* B*x* in the diagram only serves, as every mathematician knows, to show geometrically *the amount of deflection in a unit of time*, measured at right angles to that line, the space *xr* representing that through which the centripetal force alone, acting uniformly, would cause the body to fall in the fiftieth part of a second; the tangent, therefore, represents THE LINE FROM WHICH *the body would be deflected in an instant of time, and* NOT *that in the direction of which it would move with all its projectile force.*

Again, if the segment of a fly-wheel disintegrated by centrifugal force would be projected "in a straight line, whose direction is that of the tangent," the pressure which produces the fracture must act upon each particle of iron in the direction of a tangent to the circle in which the particle is revolved, for the direction of a moving body is always that in which a single force, or the resultant of two or more forces, acts to cause the motion. And it is self-evident that no amount of force, applied in that direction upon the particles in the revolving rim, could overcome the attraction of cohesion. And it is equally evident that such cannot be the direction in which the pressure acts, for whilst it is stated that the tangent is the direction in which the dissevered fragment is projected, we are informed that the force which causes the fracture acts at right angles to the tangent.

By the theory given above, however, which is founded upon observation and experiment, all the circumstances that attend this phenomenon are easily explained. And when we consider the immense increase of centrifugal force as the velocity of the rim is increased, *and the direction in which the resultant of the two forces acts*, we ought not to be surprised to find that such masses of iron can be broken and projected with so much destructive effect by this powerful agent. The operation of the sling may also, in this way, be explained in a few words. For a man, with a thong three and a half feet long, has only to give to a stone at the final effort a velocity, in a very small segment of a circle, equal to 132 feet per second, which would be at the rate of 360 revolutions in a minute, and he will project it with a force equal to that given to a ball of the same weight by an ordinary charge of gunpowder, after deducting one-third of its initial velocity for atmospheric resistance. But to "accumulate" an equal force in the circle by the strength of his arm, he would have to revolve the stone at the rate of 6850 revolutions in a minute, which is impossible.

Without intending to enter into any particulars as to the probable results of a practical application of this principle, I will close with a few remarks designed to show the amount of force excited by the rotation of heavy bodies about fixed axes, and the extent to which we may reasonably conclude it might be employed, if it could be controlled, by giving the relative proportions of the power necessary to revolve a body and the central force excited, considered abstractedly, apart from friction and atmospheric resistance. "The arc which the revolving body describes in a given time is a mean proportional between the radius of the circle and double the space which its centripetal force alone, acting uniformly, would cause it to fall through in the same time."* Consequently the diameter is to the circumference as the circumference is to the space which the centripetal force of the body would make it fall through in the time of one revolution. That space, therefore, is to the circumference as 3·141 is to unit, [3·141 being the circumference of a circle whose diameter is unit,] and the central velocity or force for an entire revolution in a second is equal

* Cavallo's Nat. Philos. p. 66.

to the circumference multiplied by 3·141. Hence *the ratio of the central force to the force in the direction of the circle, or the moving power, is as the product of the number of revolutions in a second by 3·141 is to unit.* That is, if there be two entire revolutions in a second, whatever be the weight of the body or its distance from the centre, the ratio of the centrifugal force to the moving power would be as 3·141 × 2 is to unit, or as six to one, nearly; and with eight revolutions in a second the ratio is as 3·141 × 8 to unit, or as twenty-five to one. And since "the velocity of rotation is almost unlimited,"* if a fly-wheel, similar to the one described above, were revolved at the rate of twelve hundred revolutions in a minute, the excited or centrifugal force in the rim would be equal to sixty-two and a half times the amount of power employed to give the requisite velocity, some deduction being made for friction and atmospheric resistance.

ON THE POWER OF FLUIDS IN MOTION.

In Silliman's American Journal for January last appears the following abstract of a paper read at the American Philosophical Society, "On a new Principle in regard to the power of Fluids in Motion to produce Rupture of the Vessels which contain them, and on the Distinction between Accumulative and Instantaneous Pressures: by Charles Bonnycastle, Professor of Mathematics in the University of Virginia."

Mr. Bonnycastle's investigation was suggested by a paper read by Dr. Hare, and printed in the Transactions of the Society, entitled "On the Collapse of a Reservoir, whilst apparently subject within to great Pressure from a Head of Water." Dr. Hare pointed out the circumstances attendant upon this curious occurrence, and showed how the vessel might have been momentarily relieved from the pressure of the water within, so as to make that of the surrounding air efficient in producing the collapse. The principal object of Mr. Bonnycastle's paper is to investigate the precise nature and degree of the forces brought into action in this and similar cases.

The results at which Mr. Bonnycastle arrived, are stated by him as follows:—

1. It is convenient to distinguish between accumulative and instantaneous loads, or between those which are gradually increased until the deflection due to the ultimate load is obtained, and those which commence in full efficacy from the initial position of the support.

2. Within the limits of perfect elasticity, instantaneous pressure produces twice the effect of that which is accumulative, whether the result be to produce deflection or fracture.

3. In regard to supports perfectly elastic in one direction, and perfectly flexible in the other, instantaneous action, at right angles to the axis of elasticity, produces a deflection which is to that of accumulative action as $\sqrt{4}$ to 1, whilst the tendencies to fracture are as 4 to 1. But should any case occur when the law of elasticity follows an extremely high power of the deflection, then the singular result will follow, that the deflections are the same, whether the force be exerted from the initial state or the state of load, but that the tendency to fracture will be immensely greater in the former case than in the latter.

4. In producing the fracture of natural substances, which all depart from the law of perfect elasticity as we approach the limit of fracture, the ratio of the effect of instantaneous and accumulative action will vary with the nature of the substance, never being less, for elastic bodies, than 2 to 1, nor for flexible than 4 to 1, and more usually approaching 3 or 4 to 1 for the former case, and 5 or 6 to 1 for the latter.

5. Let a vase or conduit be acted upon by a load which is alone sufficient to break it, and let this load be partly balanced by a small exterior force; should the great interior force suddenly cease, the small exterior action may crush the vase or conduit inward; its energy in such case being the sum of the interior and exterior forces.

6. Should the interior force be a vibration of the kind already explained, and should the exterior action be extremely feeble, and act on a very great mass, this extremely feeble action may crush the vase inward, with a power that shall exceed in any degree the enormous action of the interior or explosive vibration. The comparison of the interior and exterior actions is best effected in this case, by finding the modulus of elasticity of a material spring that shall coincide most nearly in effect with the interior tremor. For putting ϵ and ϵ' respectively for the modulus of the spring and of the support, and σ and σ' for the deflections resulting from the tremor acting alone, and the reaction as it does act, we have $\frac{\sigma'}{\sigma} = \sqrt{\frac{\epsilon}{\epsilon'}}$, or, in other words, the deflection produced by the reaction, is to the deflection that would be produced by the interior tremor alone, in the inverse proportion of the square roots of the moduli of tremor and support.

7. Combining what is here said with the known laws of fluids moving in pipes, and whereby they necessarily produce hydraulic shocks, it follows, that any vessel connected with such a train of pipes, and plunged at some little depth in a considerable mass of water, or other heavy fluid, will occasionally be subject to a crushing and exterior force vastly greater than the interior strain due to the constant head of fluid.

In illustration of the principles thus developed, Mr. Bonnycastle details some experiments, and mentions a phenomenon which occurred under his own notice, and is analogous to the one described by Dr. Hare. In making experiments on the propagation of sound through water, he had occasion to cause an explosion of gunpowder within a hollow metallic cylinder, open at the lower end, and immersed under the liquid; and, although the strength of the cylinder was abundantly sufficient to bear the statical pressure of the surrounding water, he found it crushed inward after the explosion.

* Fisher's Nat. Philos.

ROMAN ARCHITECTURE.

[We have heretofore had occasion to speak in praise of several articles on architecture which have appeared in the "Penny Encyclopædia," and have given several extracts; we have now much pleasure in making some additional extracts from a very able article on "Roman Architecture," which appeared in one of the recent numbers.]

With regard merely to the orders, Roman architecture presents chiefly a corruption of the Doric and Ionic, for it may claim the Corinthian as almost entirely its own, the Roman examples of that order being not only numerous and varied, but at the same time exceedingly different in character from the almost solitary specimen of one with foliaged capitals which occurs in a Grecian building. But even as regards the application of the orders, there is a wide difference between the two styles; in the Roman they are frequently employed as mere decoration, the columns being *engaged* or attached to the walls, or in some cases (as that of triumphal arches) though the columns are insulated and advanced from the structure, they are in a manner detached from it, inasmuch as they do not support its general entablature, but merely projecting portions of it. Nor are these the only differences, for besides the frequent employment of pilasters as substitutes for columns—that is, as constituting the order without columns—the practice of *supercolumniation*, or raising one order upon another, was by no means uncommon; a practice that was indeed a matter of necessity in such enormous edifices as the Colosseum, if columns were to be employed at all. From all this it will be evident that, as regards the orders alone, there is a very marked difference between Roman and Grecian architecture; yet such difference is by no means the whole, the two styles being almost opposites in nearly every respect. If there were no other distinction between them, that arising from the arch, and diverse applications of its principles to vaults and domes, would be a very material one; but we also meet with a variety and complexity in Roman buildings which does not occur in those of Greece. The only instance that we are acquainted with in Grecian architecture, of anything like grouping or combination of building, is that of the Erechtheion, or triple temple on the Acropolis of Athens. With this exception, Greek temples were merely simple parallelograms, differing from each other as to plan only in the number and disposition of the columns around the cella; consequently, however beautiful when considered separately, a very great monotony prevailed in that class of buildings, at least, in which the forms were so limited and fixed as to preclude any fresh combinations, or anything approaching to what is understood by composition.

By the adoption of the circular form in their plans, whether for the whole or parts of a building, the Romans introduced an important element of variety into architectural design; especially when we consider that to such shape in the ground plan is to be ascribed the origin of the *tholus*, or concave dome, which harmonizes so beautifully with all the rest, and renders the rotunda-shape at once the most picturesque and the most complete for internal effect,—that in which both unity and variety are thoroughly combined. The Pantheon alone would suffice to convince us that the Romans were not mere copyists, and that if as such they deteriorated the Greek orders, they also added much to the art, and greatly extended its powers by new appliances. As regards its exterior, the Pantheon presents what is certainly a strikingly picturesque (and what we consider to be also a consistent and appropriate, because a well-motived) combination, namely, of a rectangular mass projecting from a larger circular one. In that example the body of the edifice, or rotunda itself, has no columns externally; but circular peristylar temples, or rotundas, whose cella was enclosed by an external colonnade, were not uncommon. Of this kind is the temple of the Sibyl, or, as it is otherwise called, that of Vesta, at Tivoli, an edifice of singular beauty, and highly interesting as a very peculiar and unique example of the Corinthian order, the first application of which in any modern building was made by Soane, at the Bank of England. Edifices of this kind were covered with hemispherical domes, or with smaller sections of a sphere, which consequently did not show themselves much externally, as they were raised only over the *cella*, and therefore the lower part was concealed by the colonnade projecting around it. The dome of the Pantheon is hemispherical within, but is of very low proportions and flattened form without, for its spring commences at about the level of the first or lower cornice of the exterior cylinder, and is further reduced by the base of the outer portion of the dome being expanded and formed into separate cylindrical courses or gradini. If the dome had sprung immediately from the upper cornice, so as to present a perfect hemisphere on the outside, the rotunda itself would have looked merely as a *tambour* to it, and the effect would have been as preposterous as if the cupola of St. Paul's and the colonnaded rotunda on which it is raised were placed immediately on the ground, instead of being elevated upon a larger pile of building.

Polygonal forms of plan were sometimes employed, of which there is an instance in what is called the temple of Minerva Medica at Rome, which is circular on the exterior, but internally decagonal, with nine of its sides occupied by as many recesses, and the other by the doorway—a remarkable peculiarity, it being very unusual to enclose a polygon within a cylindrical structure, although not the contrary, nor to erect a cylinder upon a square or polygonal basement. Octagon plans were by no means uncommon: such form was frequently made use of for the saloons of public baths; and there is an instance of an octagonal temple, supposed to have been dedicated to Jupiter, in one of the courts of Diocletian's palace at Spalatro. Of hexagonal structures we are acquainted with no example, but a court with six sides occurs in the remains of the temple of Baalbec, not however a regular hexagon, but of elongated figure, two of the sides being 110, and the remaining four 88 feet each. In the later periods of Roman architecture, circular and polygonal structures became more frequent, and those of the first-mentioned kind deviated considerably from the original simple rotundas and circular temples. An inner peristyle of columns was introduced so as to make a spacious circular or ring-shaped ambulatory around the centre, which was much loftier than the colonnade being covered by a dome raised upon a cylindrical wall over the columns. What is now called San Stefano Rotunda, at Rome, supposed by some to have been originally a temple dedicated first to Faunus, and afterwards to the emperor Claudius, and by others to have been a public market, is a structure planned according to the arrangement just mentioned, with a circular Ionic colonnade of twenty columns and two piers. The Church of Santa Costanza, traditionally reported to have been a temple of Bacchus, but now generally supposed to have been erected by Constantine as a baptistery, and afterwards converted by him into a funeral chapel to his daughter Constantia, is a remarkable example, owing to the columns being not only coupled, but unusually disposed, and to there being arches springing from their entablature, that is, there are twenty-four columns (with composite capitals) placed in pairs, on the radii of the plan, or one behind the other, forming twelve inter-columns and as many arches: and as far as the mere arrangement goes, this interior is strikingly picturesque; but it would be an improvement, if the dome were in such case to spring immediately from the imposts of the arches, and the latter to groin into it; or at least were it to spring from the vertex of the arches.

The circular form was a favourite one with the Romans for their sepulchral structures of a more pretending class than ordinary. It will be sufficient here merely to mention those in honour of Augustus and Hadrian. The tomb of Cæcilia Metella is a low cylinder, the height being only 62 feet, while the diameter is 90; and it may be considered as nearly solid, the chamber or cella being no more than 19 feet in diameter. This cylindrical mass is raised upon a square substructure; which combination of the two forms is productive of agreeable contrast; and it was accordingly frequently resorted to. The tomb of Plautius Sylvanus near Tivoli consists also of a short cylindrical superstructure on a square basement, but is otherwise of peculiar design, one side of that stereobate being carried up so as to form a sort of low screen or frontispiece, decorated with six half-columns, and five upright tablets with inscriptions, between them. The tomb of Munatius Plancus, at Gaeta, is a simple circular structure, of low proportions, the height not exceeding the diameter, and therefore hardly to be called a tower, notwithstanding that it is now popularly called Roland's or Orlando's Tower. Of quite different character and design from any of the preceding ones, is the ancient Roman sepulchral monument at St. Remi, which consists of three stages; the first a square stereobate raised on gradini, and entirely covered on each side with sculptures in relief: the next is also square, with an attached fluted Corinthian angle, and an open arch on each side; and the uppermost is a Corinthian rotunda, forming an open or monopteral temple (i. e., without any cella), the centre of which is occupied by two statutes.

These notices may serve to convey some idea of the variety aimed at by the Romans in the distribution of the plans and general masses of their edifices, independently of decoration. Their thermæ, or public baths, a class of structures remarkable for their vast extent and magnificence, are most interesting studies of combinations of plan, as they were not merely baths, but places of public resort and amusement, and consisted of an assemblage of courts, porticos, libraries, and spacious saloons and galleries, most of which presented some peculiarity of form and distribution.

The Romans seem to have affected the practice of grouping buildings together as features in one general symmetrical plan. Their temples and basilicas were frequently placed, as the principal architectural objects, at the extremity of a forum, or other regular area enclosed with colonnades. The temple of Nerva stood at one end of, and partly projected into an enclosure (measuring about 300 by 160 feet), the entrance end of which had five open arches, and the sides were formed by screen walls, decorated with Corinthian pilasters, and columns immediately before them, over which the entablature formed breaks. Of Trajan's forum, which was surrounded not only by colonnades, but various stately edifices, nothing now remains except the celebrated triumphal column that occupied its centre, and which, so placed as a principal object, must have heightened the splendour of the whole. Like that of Nerva, the temple of Antoninus and Faustina was placed at one end of a court of moderate dimensions, whose sides were adorned with coupled columns placed immediately against the walls; and only the portico part of the temple (a Corinthian hexastyle, triprostyle) advanced into the enclosed area in front. The forum of Caracalla was nearly a square, entirely surrounded by arcades, presenting thirteen arches on each of the longer and eleven on each of the shorter sides. In the centre was a Corinthian temple very similar in plan to the Pantheon, with an hexastyle, triprostyle portico in front, and remarkable for having inner columns behind the second from each angle, so that there was a double range of them at each end, and the central space within the portico was a perfect square equal to three intercolumns.

As our object is rather to direct attention to the modes of composition affected by the Romans and the elements of their style, than to describe their chief architectural monuments, either historically or according to their respective classes and destination, we proceed now to consider some of the individual peculiarities and features belonging to their buildings.

In the application of sculpture, particularly of statues, they were prodigal; but they employed the latter chiefly as architectural accessories, frequently placing them over columns, or on the summits of their edifices as acroteria to pediments, by way of giving variety to the outline of their buildings, and also of indicating at first sight their particular appropriation—a practice almost unknown to the Greeks, there being only one instance of it. In Italian buildings, on the contrary, the practice has been frequently carried to a preposterous extent, rows of statues being placed on the pedestals of balustrades, so as almost to look like pinnacles, and to produce rather a stiff and formal effect than one of richness; whereas when they are introduced on the angles and apex of a pediment, or when there is merely one in the latter situation, such monotony does not take place, and additional importance and loftiness may be given to that portion of the edifice by such decoration. The abundant use of statues led to the adoption of the niche—a feature unknown in Greek architecture—as a convenient mode of inserting them within the surface of walls, and thereby decorating them; at the same time space was gained in interiors, where, if otherwise placed, they would have taken up room. Niches frequently occur in Roman temples and baths; and, as we have seen, from the account given of the temple of Venus and Roma, were occasionally decorated with a frontispiece of small columns, with their entablatures and pediments, but were generally left plain, and were for the most part semicircular in plan, in which case they usually terminated in an arch and semidome, after the manner of a tribune or large recess, of which the niche was in fact a miniature copy. Niches, however, were very frequently rectangular in plan, as were also exhedræ, or recesses, in which case the latter formed arches vaulted hemicylindrically.

These various applications of curvilinear forms, both in plan and elevation, undoubtedly furnished Roman architecture with resources unknown to that of Greece. Nor can it be denied that the arch itself is a very beautiful feature, although it was employed by the Romans to such excess as rather to occasion monotony than to contribute to variety of design; for if the general character of Greek temples was invariably uniform, presenting in the exterior merely lines of columns, the amphitheatres and similar works of the Romans consisted only of continuous tiers of arches, which constituted their more strongly marked features, the columns placed against their tiers being merely ornamental accessories, and comparatively of little effect, and even that not of the very best kind. In either case—the Roman or the Greek—a single compartment of an edifice, whether arcaded or colonnaded, serves as a pattern for the whole; and although uniformity and continuity conduce to grandeur, yet if precisely the same kind of uniformity recurs in every building of the same class, it becomes wearisome.

We now come to consider a practice eventually adopted, by means of which the arch and column became amalgamated as integral parts of the same ordinance, viz. that of supporting arches upon columns, making them spring either directly from their capitals or from an entablature-shaped block over them. We are aware that this practice is almost uniformly condemned as barbarous and absurd; yet in our opinion somewhat too hastily, and with more of prejudice than of fair examination. That it was introduced during the decline of the art, and that it was an innovation subversive of former principles, is not to be denied. Yet if it must be reprobated, it ought to be so for its own demerits, not as an innovation; for all invention is such. It appears a very poor argument against it, to say that columns were originally designed to support horizontal architraves; we do not see how that circumstance, of necessity, renders every other application inadmissible. At that rate we must censure as vicious a great deal of both Roman and modern architecture, where attached columns are employed merely as ornaments, yet, as frequently as not, in such manner as to produce a character of littleness and poverty, they being so small in proportion to the rest as to appear insignificant, and at such intervals from each other that all the beauty and harmony of a columnar ordinance is lost. Where columns are employed to support, it certainly cannot be alleged that they are idle unmeaning expletives: nor that they are mutilated by being apparently partly embedded in the wall behind them. "A pier," it has been remarked by an intelligent waiter, "is but a differently shaped and more massive column:" which being granted, what impropriety can there be in employing the latter as a substitute for the other, provided it be done with judgment and discretion, and where, upon the whole, it will prove an advantageous mode of treatment? It certainly is a barbarous mode to turn small arches upon columns, which are not more than between two and three diameters apart, of which we have examples in the basilica of S. Paolo, and Santa Agnese fuor delle Mura, at Rome. The intercolumns are such that they might easily have been closed horizontally: indeed the openings between the columns have scarcely the appearance of being arches; but the whole looks as if the wall resting upon the columns was scooped out into diminutive arches over the intercolumns. In those instances, too, the arches themselves are quite plain, without archivolt or mouldings of any kind, and consequently all keeping is destroyed: the architectural embellishment terminates with the capitals of the columns, and so far the effect is similar to what would be produced by placing a plain horizontal mass upon a range of columns, instead of a moulded entablature. Although one of an opposite kind, it is equally a fault to make the arches spring not immediately from the capitals of the columns, but from square fragments of entablature over them (as, for example, in the interior of St. Martin's, London) not only because such fragments are unmeaning in themselves, and suggest the idea of the columns having been found too short for their intended purpose, but because they remind us quite unnecessarily of the original application of the column to the horizontal entablature. If entablature be admissible at all, it is when the columns are coupled, as in the church of Costanza already noticed: for then some kind of architrave at least becomes requisite, in order to connect the two capitals, as it were, together. One very great advantage attending the combination of the arch with the column as its support, is, that it allows the openings to be considerably wider than they otherwise could be, because such intervals as would produce a poor and straggling effect in a colonnade, become well proportioned and agreeable when spanned by arches. Such columnar arcades have frequently been employed by the Italians with happy effect in *cortili* and places of that kind, where piers of the usual kind would obstruct the view too much, and where intercolumns of the same proportions, between pillars supporting a horizontal entablature, would have a poor and disagreeable effect, particularly if, as is generally the case, other stories of the building rested upon the porticoes below. In fact, ordinances composed of arches and pillars constitute the best specimens of Italian columniated architecture. That in the cortile of the Palazzo Piccolomini at Siena, the work of Francesco di Giorgio, is singularly beautiful in its distribution, remarkable for the richness of its details, and also for the variety which it presents in perspective, as may be judged from the view of it given in Grandjean and Famin's "Architecture Toscane." We have already mentioned the interior of St. Martin's as containing an example of arches upon columns, and that of St. Bride's, London, furnishes another, but neither is a favourable one. A more satisfactory example may be found within the loggia of the Strand portion of Somerset House, where, though the arches spring from entablatures over the columns, yet as the latter are placed in pairs, those horizontal parts are more than mere upright blocks over the capitals. The quadrangle of the late Royal Exchange, London, had arches springing immediately from the capitals of the columns, but their breadth was excessive in proportion to the height of the latter, and their elliptical form was a great defect, and certainly did not at all contribute to beauty. All that we contend for is the principle on which the practice is founded; for as to the merits of the buildings in which it is adopted, that must, like every thing else in architecture, depend upon the taste shown in the particular application of it, which may be exceedingly good or altogether the reverse. Hungerford Market affords a good example of an ordinance composed of columns and arches, and also an idea of the general character of a basilica, though of course somewhat modified, and without any sort of architectural luxury.

ARCHITECTURE OF LIVERPOOL.

NORTH AND SOUTH WALES BANK.

In an article in thy Journal headed the Architecture of Liverpool, signed H., occurs the following sentence. "This is an example of the effects of modern competition, where the successful architect, having had his design adopted in consequence, it is said, of his private interest in the committee of management, has not only the advantage, as was understood at the time of examining those of his competitors, during the six weeks which elapsed between the decision of the committee and the return of the designs to their respective authors, but is permitted to expend about twice the amount to which they were in the first instance limited;" which under the mean mark of, "it is said," hides four distinct assertions meant to reflect discredit on the committee of management and on myself,—all four are thoroughly untrue. In the first place 1, the architect, had my design chosen unanimously by the committee, without the interference of any private interest. Secondly, I did not either at the time of the designs being before the committee, or any other time see, or have opportunity to see any one of them, (excepting only the one considered second best, sent by Mr. Leigh Hall, of Manchester, and to see which, I went to his office by his own invitation some months afterwards.) On the contrary, the manager of the bank carefully kept them unseen after the decision, until at various times they were sent for by their owners—considering it his duty to the unsuccessful architects; and certainly I should not have been mean enough so to examine them, or under the shuffling cloak of the words "understood at the time," to assert and publish anonymously that any other person did so, unless I had known it of my own knowledge. Thirdly, The time the plans were in the directors hands was four, and not six weeks, and during all that time I was engaged in a tour in the west of Scotland and the north of England. And fourthly, no amount whatever was named to limit the architect, and the sum expended is not greater than was anticipated, and shown by the architect, except such part of it as is due to the fact of the foundations having to be taken down 27 feet below the surface, in consequence of the discovery of the site being partly that of the old castle ditch of Liverpool, and which part of the cost is well invested by the building in that depth, strong and valuable bonding vaults. I send a ground plan by which you will see that H. contradicts himself, by stating that the obtuseness of the angle is rendered "most painfully obvious," by my having placed the line of wall "at right angles to the long side, and therefore not parallel to its own line of front;" *it is* parallel to its own line of front, and therefore is 6¼ feet in 35 more obtuse than a right angle; surely the writer must have distorted vision who could not see the difference between an angle of 101 degrees and a right angle, even when it was rendered "most painfully obvious," the fact shows that the obtuseness of this angle was a "difficulty" so "overcome," as to baffle his discernment. That I have taken away by my pilasters two feet in width, and by the entrance five feet in length, is untrue; the bases are allowed by the town's authorities to project beyond the building line, and the space from the front of the pilaster to the inside of the stone work of wall is just two feet, so my judicious and veracious friend H. would leave nothing for the thickness of the wall; this blunder arises no doubt from the common practice of making pilasters merely accessory; in my building they *are the wall*, and are throughout the structure *the support*. The building has been admired not only by your judicious writer "Eder," but by many whose opinions are at least as well worth having as that of the sharp-sighted H.

I am, respectfully,
EDWARD CORBETT, *Architect*.

King Street, Manchester,
3rd Month 2, 1841.

RAILWAY ACCIDENTS.

SIR—As the greater number of fatal accidents which have recently occurred on railways may be fairly (at least in my opinion) traced to a want of sufficient look-out ahead, it has occurred to me, that great advantage would result from having a third person as a conductor on the engine, whose duty it should be exclusively to attend to the signals, keep a look-out ahead when the train is in motion, and apprise the engineer of any other train, workmen, materials, &c., being on the line from which danger may be apprehended, as also to apprise such train, workmen, &c. of the approach of that to which he is attached.

This person should not be associated with the engineer and stoker on the stage behind the fire-box, but should be elevated on a seat before the chimney, where he would at all times have a much better opportunity of keeping a look-out than the engineer has, whose view is often partially or entirely obstructed (as I have frequently observed) by the steam escaping from the valves, or by the smoke and steam from the chimney, besides the disadvantage the engineer always labours under in looking along the side of the boiler. The situation of the conductor would be particularly advantageous in the night for observing the signal lamp of a train in advance, which from its position may be easily overlooked by the engineer, who has the light of his own fire to distract his attention.

The situation of the conductor which, is herein advocated, I am aware would be attended with little advantage without an adjunct. I therefore propose that there should be two whistles on the boiler, over the fire-box, with levers and rods attached to them, leading to the seat of the conductor, so that by means of them he may easily communicate with the engineer, or give warning to the train or workmen, &c., on the line before him. One of these whistles should be used as a warning only, and the other to convey to the engineer a peremptory order to stop the engine in case of a sudden emergency. The engineer should still have, as at present, the means of working the cautionary whistle, independent of the conductor; and he might be furnished with an apparatus to arouse the attention of the latter in case of his being in doubt.

The responsibility and attention of the engineer would not necessarily be diminished by the adoption of this plan, on the contrary, while he should be required to keep as vigilant a look-out as at present, the superior situation of the conductor would be a great additional security to the lives and property of the public. The directors of railways incur, as was very properly expressed by them at their late meeting at Birmingham, a fearful responsibility, and it behoves them to take every precaution in their power for the protection of the lives and property intrusted to their care.

Should this suggestion prove to be the means of lessening the danger of the public, and the responsibility of those whose duty it is to protect them, the object I had in view by troubling you with this, will be fully answered. Begging the favour of your giving this a corner in your valuable Journal,

I remain, Sir, your most obedient servant,
A CIVIL ENGINEER.

Thornhill, near Wakefield,
March 11, 1841.

PUBLIC SAFETY AND CONVENIENCE.

SIR—It is to be hoped that the recent accident of two houses falling down in so public a thoroughfare as Fleet Street, which is constantly thronged during the day time, will at least have the good effect of exciting greater vigilance for the future. But, at present, it seems there is no adequate authority which can interfere imperatively and instantly in such cases; or, if there be any authority and responsibility, there must be most scandalous and criminal negligence somewhere or other.

Passing the other day through that not very refined but now classical locality of Pickwick celebrity, yeleped Goswell Street, I was struck by the frightful manner in which, owing to the accumulation of earth behind it, the churchyard wall bulges out above in such manner, that it looks as if about to give way. Would it not, therefore, be advisable to ascertain whether there is any real danger of its doing so, and whether it would not be prudent to strengthen it by buttresses at intervals?

That far greater attention is paid to the comfort and security of pedestrians in London than in any other capital or city, may be readily admitted; nevertheless there are improvements which might be adopted, were all that relates to the care of the public streets placed under the control of a general Board for the whole metropolis. Though it may be thought a very trifling matter in itself, it would be well were there some kind of authority to regulate the names of streets, and thereby prevent the inconvenience sometimes occasioned by the same name being borne by half a dozen or half a score different streets in various parts of the town. Surely it would not be a matter of great difficulty to find a distinct name for every street, even were the metropolis to grow to twice its present size. Therefore, although to attempt now to correct the present nomenclature, by naming afresh some of our numerous George Streets, King Streets, Castle Streets, might occasion as much confusion as it would obviate, there might be a regulation, ordering that in future, no new street should have a name already appropriated by some other.

Far more essential is it to the public that they should be enabled to cross such exceedingly wide carriage ways as those in Oxford Street, Regent Street, Charing Cross, Whitehall, Holborn opposite Furnival's Inn, &c., with less inconvenience and danger than they now incur. What objection there can possibly be to erecting a lamp-post here and there, with short posts around it, so as to form a secure spot midway of the crossing where foot-passengers might stand in security, it is difficult to conceive. It is true something of the sort has been done already, but not effectually; for the crossings are still left dangerously wide, as for instance, that opposite Northumberland House, where there ought to have been two lamp-posts and resting-places instead of a single one. Besides, why should there be none at all in Regent Street, &c., where they are quite as much wanted? or does it not matter whether people be run over by carriages in those particular places? Another thing that might be attended to, were it made any body's duty to do so, is the sweeping the crossings in dirty weather, for the swept pathway is generally so narrow, that if two persons meet, they must either jostle against each other, or one of them step into the mud. At the time of the thaw, some weeks ago, the streets were almost impassable for foot-passengers; which would not have been the case had the snow been entirely cleared away from the crossings, leaving there a passage of about 12 feet broad.

There ought to be some regulation for providing *urinals* at suitable distances, whereas, at present, there seems to be no regulation at all in regard to them, that being a public accommodation left entirely to chance; so that in many parts of the town it is difficult to meet with any place of the kind. Yet, if no where else, one might be fixed at the entrance to every carriage mews; and not only might they be better contrived than they usually now are, but it should be made the duty of the police to see that they are not scrawled over in the disgusting manner they frequently are.

Unfortunately it is worth nobody's while to make a stir about such matters, because they are not of the kind which the newspapers gabble about. No! any one might gain greater celebrity any day by merely standing on his head at Charing Cross.

I remain &c. &c.,
A PEDESTRIAN

Metallic Relief Engraving.—As you are ever anxious to give the first tidings of new inventions, I doubt not the two following embryo methods of engraving will be as interesting to yourself as to your readers:—Take a tablet of plaster of Paris, and, having heated it, apply wax for absorption to all the faces save that on which you intend yo r drawing to be, and to that one apply your drawing, executed with lithographic ink, on lithographic transfer paper. Let the side of the tablet on which is the transferred drawing, be now dipped in weak acid and water, and then permitted to absorb a solution of sulphate of copper. By electro-metallurgy a deposition of copper can be made on all parts s ained with the sulphate. Ere this coating be too thick, let the tablet be removed from the vessel in which this last operation has been carried on, washed *carefully*, dried, and a mixture of isinglass and gin be poured on it: its redundancy be gently blotted off with blotting-paper till the surface be level (*i. e.* the copper lines and isinglass cement be of the same height), again, let the deposition take place, and again its succeeding operation, after which let common black lead be rubbed over the whole surface; and the deposition being renewed, a copper mould, from wh ch a type metal block may be subsequently cast, is now formed.—*Another method.*—Draw with a pen dipped in warm isinglass coloured cement, and when your drawing be dry, for an instant expose it to steam, and then coat it with leaf gold. Proceed by electro-metallurgy, as in last method, and no cast is necessary.—*Athenæum.*

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXV.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. It were to be wished that some of those who profess to admire Palladio, would be at the trouble of specifying his particular merits and beauties by pointing out striking instances of them in his works. Instead of which they deal only in vague eulogium, which teaches nothing. Surely they do not mean to say that it would not be worth while to perform so good an office for their favourite, nor can we imagine that it would be either a difficult or a disagreeable one to themselves. On the contrary it would afford them the opportunity of dwelling upon his excellences one by one, while such analysis of them might perhaps enable them to detect, to a certain extent at least, the secret of his peculiar art in composition. Neither would the task be at all superfluous, because I have met with others besides myself, who have confessed that they have not only been struck by egregious faults and solecisms in Palladio, but have been utterly unable to perceive any counterbalancing merits in him,—at the best no very striking beauties. For my own part I should say there is scarcely any work of Palladio's which does not afford an instance of something or other tasteless or faulty. By no means do I intend to deny that there are many useful elements to be derived from them, but as exhibited in his own compositions, they are either valueless, or else overpowered and neutralized by the rest.

II. It is likewise not a little remarkable that after Professor Hosking's bold attempt "to disabuse the public mind as to the merit of the work of Vitruvius," not only the public but professional men should continue to speak of it with implicit deference as before, and without attempting in turn to vindicate it from the aspersions so cast upon it, just as if the opinion put forth in such diametrical opposition to their own, had been given to the world anonymously in some obscure newspaper paragraph, instead of proceeding from an authoritative quarter, appearing in a treatise in the Encyclopædia Britannica, afterwards published separately, as a manual for students, consequently likely to prove extensively mischievous—at least in the opinion of those who still continue to "swear by Vitruvius," looking upon him as an infallible oracle. If such persons are perfectly sincere—which is somewhat problematical—their silence argues a great want of moral courage, since they patiently allow their oracle to be treated with contumely and indignity, without reproving the offenders:—unless indeed it be by merely affecting to sneer "at the small fry of critics who carp at Vitruvius." Such cool contempt may look very magnanimous, but it is in reality little better than cowardice, and a virtual acknowledgment that the less the merits of Vitruvius are inquired into, the better for him and his admirers. It is not denied that his writings have some interest, but then it is almost entirely in a philological point of view. They may occasionally help to elucidate archæological facts; but as far as the study of the art is concerned, they require to be elucidated by means of the other more satisfactory and more copious sources of information now opened to us. Perhaps it would have been a blessing to architecture had they never been discovered, for they have undoubtedly exercised a baleful influence on the Italian school, since had it not been for the blind deference paid to them, it is probable that on the revival of Roman architecture, the great masters would have freely imitated the orders of antiquity, instead of cramping the art, by establishing positive rules for each, and by endeavouring to make them conform as nearly as possible to the *recipes* given by Vitruvius;—in contradiction to that license—if it must so be termed, which manifests itself in actual examples—not those afforded by buildings alone, but by detached specimens and fragments, some of which are infinitely more valuable as artistical studies. Would Vitruvius help us to the Tivoli Corinthian, or to any of those varieties of the Ionic capitals, &c., which we meet with in Piranesi's "Magnificenzes"? Vitruvius and the Italians who have given us their codes of the orders, would reduce each to a single *pattern*: Doric, Ionic, and Corinthian, must each be put into its respective uniform, the precise cut of which is established by their martinet regulations, which, like the laws of the "*Maids* and *Parsons*" as Hook calls them—are to remain unaltered.

III. In this country architecture—or at least the study of it, seems to be just now marching at quick pace—backwards. While the Institute is forming a collection of the various editions of Vitruvius, the Royal Academy Professor is instilling some very odd notions into his audiences;—of course quite orthodox, since he himself must be looked upon as the very centre and fountain of orthodoxy; nevertheless far from being of the most enlightened kind, or manifesting a genuine *Catholic* love of the art. Wren seems to be the god of his idolatry—the master to whom he would refer us at the present day as the standard and compendium of architectural excellence. He claims our admiration not only for St. Paul's,—which we most readily concede, but for every other production of Wren's, although the majority of them possess no beauty whatever, but on the contrary display utter want of taste, and scarcely any invention.

IV. I am sometimes inclined to wonder, not that architecture should not be cultivated as a mere study, but that it should have any volunteer followers at all, for the silly trifling, the dulness, the pedantry, the bigotry, the extravagant galimathias, the downright nonsense, one has either to *wade* through, or else *evade* by skipping over,—are enough to disgust people with most treatises on architecture. As a mere vague, indistinct poetical analogy, something of the kind may be fancied to exist between architecture and music; but to adopt such speculations seriously as Vitruvius suggests—although he has not explained *how* we are to set about doing so, is sheer extravagance—a will-o'-the-whisp chimera, a delirium of the intellect. A thousand other analogies just as much to the purpose, just as substantial, and not a whit more whimsical might be traced by any one who chooses to be at the trouble of doing so. For instance, I myself would engage to show the analogy between Architecture and Cookery much more clearly and explicitly than has hitherto been done in regard to that fancied to exist, between Architecture and Music. The fantastic opinions promulgated by some in regard to architecture, convince us that Swift's Laputa is no caricature—quite the contrary, for the idea of extracting sunbeams from cucumbers, or of applying trigonometry to tailoring, seems perfectly rational compared with Michael Angelo's queer crotchet—viz., that a knowledge of anatomy is indispensable to the architect; or with the crazy metaphysical rhapsodies of Padre Georgi and his "Platonic principles" in architecture! what lunatic reveries!

V. Among the very queer things which have fallen from the Professor's lips during his course of lectures, may be reckoned, his admonition to students to avoid aiming at the Picturesque in architecture. Without going any further, it would be sufficient to remark that the advice, however salutary, is perfectly superfluous, for whatever else may be alleged against modern architecture and architects, it is quite impossible to lay picturesqueness, or the aim at it, to their charge. On the contrary we see building after building erected, which are remarkable for nothing so much as the entire absence of all picturesque quality, so that if not amenable to criticism when examined by standard rules, they are quite spiritless and insipid. Even allowing that the advice was intended chiefly as a caution to the junior students, to guard them from the error of attending chiefly to such effect, and overlooking more important considerations,—it does not seem to be of the soundest and most wholesome kind. If the architect intends to become more than a builder, we should say, it is highly important that he should begin to cultivate his taste, to exercise his fancy as soon as possible. For if the imagination is to be restrained until the judgment shall have been matured, and until proficiency in practical knowledge shall have been attained, the probability is that there will then exist no imagination to be brought into play. To expect that they who begin as plodders will end as artists, is to expect the order of nature will be reversed—that after-life will prove the season of genial inspirations and high imaginings which never came across the mind in youth—and that after years of torpidity and dulness, the powers of fancy will burst forth with peculiar vigour. Methinks it would have been greatly more to the purpose had the Professor exhorted his pupils to endeavour to secure picturesque quality in the first sketches of their ideas upon paper, and then rigorously to revise them, correcting, sobering down, maturing, until the whole should satisfy the judgment as well as the fancy. If, indeed, the principal or sole merit of a design consists in its being picturesque, it will be more or less defective in more essential points: yet that quality in itself is not a defect, unless it can be shown that every thing else has been sacrificed in order to obtain it. I almost wonder the Professor did not follow up his admonition by a fling at that specimen of the picturesque in architecture which his predecessor both at the Academy and the Bank of England,—has given us in the North-west angle of the last-mentioned building. And except that, there is hardly another instance about town, where picturesque expression has been studiously brought in, unless it be in that very strange piece of architecture in the Assurance Office in the Strand, which the Professor should have held out *in terrorem* to his pupils, and held up in derision to his audience generally.

VI. Some one, I find, has been liberal enough to say of me in a newspaper critique on one of the late numbers of the "Civil Engineer," that if I wanted a motto, I might take "Castigat Ridendo" for the purpose, and that my remarks, though "exceedingly pleasant, are also confoundedly caustic, original withal, and full of matter." This is certainly encouraging, and holds out to me the hope that the continual drippings of my pen may in time make impression somewhere, and wear away some of the prejudices against which they are directed. Inveterate errors—errors, moreover of a *respectable* kind, and sanctioned by what passes with the world for paramount authority in all such matters—are not to be exploded in a day, but are rather to be worn away by constant filing. The great thing to be accomplished, if we would advance architecture, is to diffuse a taste for it among the public. For this no stone should be left unturned; nevertheless, it is precisely the very point which is never taken into consideration at all. And why? because none, be they either individuals or societies, feel their own immediate interests concerned in it. It is all very well to string together a parcel of pompous words and phrases about encouragement of art. But it is all moonshine—all gammon! for it has not even the poor merit of sincerity, being no less hollow that it is shallow.

VII. Professor Hosking does not hit the right nail on the head, when he lays so much stress upon the importance of practical knowledge. At any rate, as far as architecture is concerned, it is not there that our deficiency is most apparent. Not a few buildings might be enumerated which, though perfectly irreproachable in respect to construction, are altogether unsatisfactory, absolute nullities and naught, if we consider them as productions of art—and were we not to allow them to be such, their authors would be ready to *Cardigan* us. There are people, nay, professional ones, who affect to hold all that belongs to taste—to the æsthetical part of architecture, as matter of indifference. Possibly they may be sincere—the greater probability is that they are not; but if they are both sincere and consistent, with what utter scorn must they look upon—as what arrant rubbish must they regard, nearly all that has been written upon architecture, whether by Vitruvianists or Palladianists, by Greeks or Anti-Greeks, by Goths or Anti-Goths. How must they in their hearts despise all the wordy strife and contentious babblings and gabblings with which some square miles of paper have been covered!

CHEETHAM CHURCH, &c.

Sir—It is to be hoped that the example set by your correspondent who has furnished the account of the church at Cheetham will be followed by others; for similar descriptions of buildings lately erected or in progress in different parts of the country, would prove valuable information, if only as directing inquiry to what is deserving notice. And since architects themselves are, it seems, very backward in communicating intelligence of the kind, all the more desirable is it that it should be volunteered by other parties. Still, though the description here mentioned is sufficiently full and satisfactory upon the whole, the writer has omitted to state the dimensions of the building, to which he might have helped us by some sort of calculation in round numbers, though he might not be able to tell the precise admeasurements. Neither would it have been amiss had he informed us at what time the church was began and completed, for both dates and dimensions are rather important items in all architectural descriptions, quite as much so as that of cost, which last, however, seems to be invariably the uppermost consideration of all with Mister John Bull.

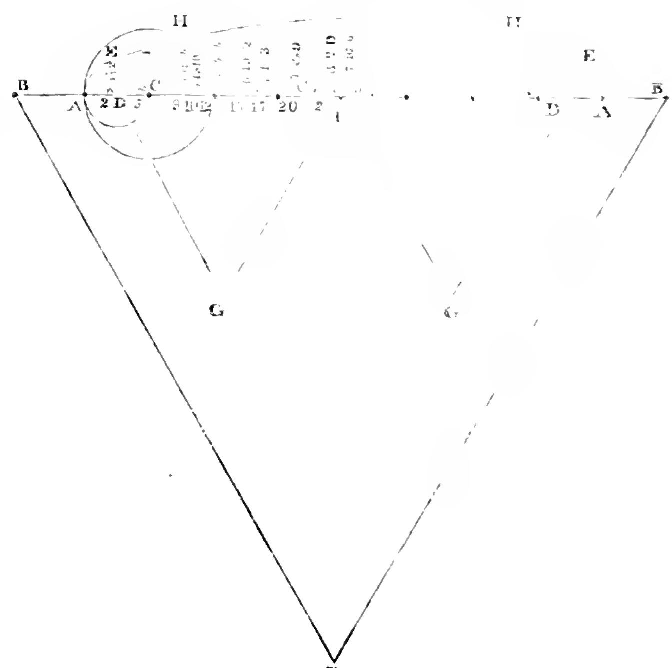
While I thank the writer for his communication, I must say there is one expression which I think he had better have left out, for I can readily perceive no modesty whatever in his affecting to call himself "an incompetent person," at the very same time that he adds "architect" to his name; for unless it plainly appears to the contrary, it may be presumed that a professional man is tolerably competent to draw up an architectural description.

H.'s strictures on the "Banks," &c., at Liverpool, contain so much sound criticism, and are written with such spirit and ability, that I sincerely hope you will be able to prevail upon him to extend his observations to other buildings in that town. If he choose to do so, he might probably be able to make some communication relative to the intended "Assize Courts," and "St. George's Hall," both which almost seem to be abandoned, at least for the present. It is, therefore, desirable to know why so much fuss should have been made at all, if nothing is to come of it.

You will think that I am going to review nearly all the articles in your last number, still, I must be allowed to say a word *en passant* to Mr. East, and without expressing my opinion on his paper generally, observe that it would have been not at all less to the purpose, had it specified a few of Campbell's works, and instanced in them those peculiarities which he notices. He might, too, at the same time, have enlightened such blockheads as Candidus and myself, by pointing out in what buildings or designs of Palladio's we are to discover that "grand simplicity and rich excellence"—*risum teneatis!*—which he claims for him. I have spent half a day in looking over a set of his works, yet, hang me if I can find out any thing of the kind in any one of them. Mr. East will, perhaps, say that then I fairly deserve to be hanged without benefit of clergy. I am, therefore, resolved to hang—no, I don't mean to hang myself, but to *suspend*—my pen for the present.

I remain, &c. &c.,
John Croker.

ON THE CURVATURE OF THE ARCHES OF THE BRIDGE OF THE HOLY TRINITY.



Sir—In looking over some old plans, I fell in with my solution o the curvature of the arches of the bridge of the Holy Trinity at Florence, as far back as January, 1826. I was induced to attempt this solution in consequence of a paper published in the Quaterly Journal of Science, edited at the Royal Institution, by Samuel Ware, Esq., April, 1823, Vol. 15, at the same time having a bridge to erect over the College River, where the situation required a bridge of similar construction.

"ON THE CURVATURE OF THE ARCHES OF THE BRIDGE OF THE HOLY TRINITY AT FLORENCE. BY SAMUEL WARE, ESQ.

"To determine the curvature of the arches of the Most Holy Trinity, erected over the Arno at Florence, by Bartolommeo Ammanati, is a problem which still occupies the attention of antiquaries, mathematicians and architects. Some account of the interest this question has excited will be found in Ferroni's tract, entitled 'Della vera curva degli archi del Ponte a S. Trinita di Firenze: discorso geometrico-storico,' inserted in the 11th vol. of the 'Transactions of the Societa Italiana delle Scienze.

"When it is observed that the curvature of these arches affords the flattest roadway and the greatest waterway, with the smallest quantity of material, of any stone bridge ever constructed; and taking into consideration that cast iron is ten times stronger than marble, and twelve times stronger than common stone in compression, and that the vault of this bridge is less in depth from intrados to the extrados than any iron bridge hitherto built, with relation to the radius of curvature at the vertex, we shall not wonder that the inquiry should be continued until a satisfactory solution be obtained."

The annexed construction gives every ordinate to an extreme exactness when executed with accuracy, as shown by the figures in the annexed diagram. Also the chord of the smaller arch of 45° 15′ 4″

by the same construction gives 7° 3′ 5″ as the versed sine. *Vide* Quarterly Journal of Science.

I am, Sir,
Your very obedient servant,
EXPERTUS LOQUI.

Wooler,
25th January.

GEOMETRICAL SOLUTION.

Construction.—The span or chord AA being given, subdivide it accurately into eight equal parts. Add to each extremity of the chord AB also an equal part, the semi-diameter of the piers. Bisect the extreme divisions of the chord AC in D, and with DA as a radius, and D as a centre, describe the circle AEC. Then, from the centre of the chord F to the point D as a dimension, make the equilateral triangle FGD, and continue the line GD to E—E is the point of intersection. Next, with CA as a radius and C as a centre, describe the circle AH; then take AF (one half the chord) as a radius, and G as a centre, describe the arc EH—H is also a point of intersection. Lastly take the base line BB as a dimension, and make the equilateral triangle BIB, and with HI as a radius and I as a centre, describe the arc HH, which gives the required curve.

WOOLF'S DOUBLE CYLINDER ENGINE.

SIR—An estimate has been given of the power of Woolf's double cylinder rotary engine, at page 50, February 1841,—on assumed conditions of steam pressure, so much at variance with those which could occur, that I conceive further observations are required to elucidate this subject.

In regard to the Cornish engines, perhaps it would be difficult to assign to each their relative position in the scale of merit, in the introduction of the improvements by means of which so great an increase of work has been obtained in Cornwall.

Woolf's advocates may fairly point to the reported duty of his engines, which for a long period maintained their position at the head of the best—at present neither his engines or boiler are in use. Trevithick, who was equally well known as an advocate of high steam, went to America just at the critical period when the results of the rivalry established among the mining engineers had began to develop itself. His boilers still keep their ground, and have afforded other engineers the means of working high steam expansively in Watt's engines, with an effect far exceeding that as yet obtained from Woolf's engines.

In the former the calculations for expansion are well known—but in the latter the original volume of steam cut off is driven into another cylinder during expansion—while the mean pressure of this steam reacts against the full pressure steam by which the smaller piston is impelled.

The admission however of the steam into the small cylinder may be cut off at any portion of the stroke, and worked expansively during the remainder, and may then be further expanded in the large cylinder, so that the assertion that "the capacity of the smaller cylinder naturally determines the quantity of steam which the boiler must supply," is untenable.

The only safe assertion respecting the steam pressure in the cylinder would be that it is lower than that in the boiler, and the difference was only considerable, especially in Woolf's practise, from his opinion in favour of wire-drawing high steam, and the small allowance of steam room in his boilers.

Supposing the safety-valve of a boiler loaded with 10 lb. per square inch, it is not probable that the constant total pressure in the cylinder would exceed 40 lb., including atmospheric—that is, 14·75 + 25·25 lb., having a volume of about 670 for one of water. Had the steam been expanded at 40 + 14·75 = 54¾ lb. the volume would have been 520 for one.

During expansion on the given conditions of the respective cylinders, the mean pressure of the steam would be about 17 lb. per square inch on the large piston, with a reaction of 17 lb. per square inch on the smaller piston—against the pressure of 40 lb. full pressure steam on the other side—hence

$$\text{Small cylinder } \frac{207{\cdot}39 \times 40 - 17 \times 176{\cdot}34}{33{,}000} = 25{\cdot}5 \text{ H. P.}$$

$$\text{Large cylinder } \frac{660 \times 17 \times 212}{33{,}000} = \quad 82{\cdot}28$$

Absolute power - - -	107·78
Friction = ⅓ - - -	35·92
Effective power - - -	71·86

Taking similar conditions of water evaporation, and cubic feet of steam required, we should have $\frac{16800}{670} = 25$ cubic feet of water per hour, and at 8 lb. of water from 1 lb. of coal, the consumption would be about 2 lb. of coal per horse power per hour.

Numerous causes might produce a consumption of 4 or 4½ lb. of coal per hour, the difficulty would be the reduction of the coal expenditure to the quantity theoretically calculated as sufficient. Instead of low pressure engines, the proper standard for Woolf's, are Watt's engines working high steam expansively, both using similar boilers and coal.

I am not aware of any trials under these conditions, which can be considered conclusive in regard to their relative merits.

I remain, your obedient servant,
Y.

March 11.

CONSUMPTION OF COKE—GLOUCESTER AND BIRMINGHAM RAILWAY.

SIR—In Whishaw's Railways of Great Britain, page 30, there is a statement taken from a paper by Capt. Moorsom relative to the performance of a locomotive engine imported from the United States, that in seven journeys of 596 miles up to Birmingham, the engine conveyed 682 tons gross, and consumed 177 sacks of coke (1½ cwt. each), and in seven journeys of 596 miles down from Birmingham, the same engine conveyed 629 tons gross, and also consumed 177 sscks of coke.

Mr. Whishaw observes, "Thus the consumption of coke, according to this statement, taking the average of the loads up and down, was at the rate of only ·007 lb. per ton per mile!!"

The meaning of Capt. Moorsom's statement seems to be that the engine passed over twice 596 miles with a mean load of 93·64 tons, and consequently her consumption would be ·541 lb. of coke per ton per mile.

It may not be difficult to account for Mr. W.'s erroneous figures; if $\frac{682+629}{2}$ had been the mean load carried, the consumption would have been about ·07; and a mistake in the position of the decimal is not uncommon. I cannot account for the two notes of admiration so readily, as they prove that his attention was called to extraordinary apparent economy of the consumption of coke.

I remain, Sir,
Your obedient servant,
Y.

March 11.

MONUMENT ERECTED AT LIMERICK TO THE MEMORY OF THE LATE VERY REV. DR. HOGAN.

WE were yesterday favoured with a view of the monument just erected in the parish chapel of St. Michael, to the memory of the late very excellent and justly esteemed pastor; and we freely acknowledge that, in classic chasteness of style, correct architectural proportions and superior beauty of execution, the monument surpasses any thing of the kind heretofore seen in this part of the country, and probably not inferior in these qualities to any other specimen of modern sculpture in the Kingdom. The appearance of this memorial to departed worth is at once imposing and elegant, and the eye loves to rest with pleasure on its sublimity of conception, the elaborate beauty of its detail in the various compartments, and the superior finish of the workmanship, from the most minute object to the most prominent, which is a figure of the Archangel Michael. Well may the subscribers be proud of such a lasting record of the virtues of him whom it commemorates, and happy may the highly gifted and eminent artist feel, the production of whose taste and ability it is. Mr. Bardwell, of London, is that gentleman, and at present engaged in the erection of that magnificent edifice, Glenstall Castle, in this county.

It is a mural monument, of Gothic architecture, at the period of the 15th century, and the details are principally taken from the Chapel of Henry VII., in Westminster Abbey; also, from the Chapel of Magdalen College, Oxford. The monument, which partakes somewhat of the character of a shrine, is apparently borne aloft, or supported, by four angels, correctly copied from the works of Wainfleet, Bishop of Winchester, and founder of Magdalen College. One of the angels bears a shield, another a book, another a censer, and the other a lily—this last, which is particularly beautiful and true to nature, was a favourite emblem of Wainfleet's, and figures in many parts of Magdalen College. The design consists of three compartments, divided by boldly projecting buttresses terminating in richly crocketted finials, subdivided by rich and elaborate tracery into smaller ones. The whole design may indeed be considered allegorical, consisting of a number of beautiful figures, each having reference to the spiritual duties and pious characteristics of the deceased clergyman. For example, one of the figures represents St. Peter as Prince of the Apostles; another St. Patrick, the patron of Ireland; another St. Roche, a figure emblematical of our short pilgrimage in this world; while the patron saint of the chapel in which it stands, and in which the deceased officiated for 26 years, occupies the centre compartment, exhibiting a drapery containing the inscription.

The exquisite beauty of this figure is remarkable and is worthy of earnest attention, the spreading pinions, the calm angelic sweetness and dignity of the countenance, and the serpent writhing in agony beneath his foot crushed to the earth by his delegated power, all unite to form a combination of grace, elegance, and skill in design and execution which cannot fail of raising in the mind of the spectator the highest admiration. The accuracy and ability displayed in the portraiture of the serpent, especially about the head, are wonderful: in the three niches at the other side are two figures of alcolites, one bearing wine and the other bread, and in the other the figure of a mitred abbot in his ecclesiastical costume, to continue the allegory as to the station and rank of the deceased. Over these objects, the cornices are most elaborately sculptured and crowned by a rich border, with the usual finish of the period, a strawberry leaf and ball, with the Tudor flower interspersed. The monument, which is all of the purest white Italian marble, is projected on a magnificent black slab, 13 feet by 7, from the Ballysimon quarry, in the neighbourhood of this city, and its erection has been, this day, completed by Mr. Garvey, of Catherine Street, under the direction of the artist, Mr. Bardwell, who has been most particular in seeing to its security and completion. —*Limerick Chronicle.*

NEW INVENTIONS AND IMPROVEMENTS.

IMPROVEMENTS IN STEAM ENGINES AND PADDLE SHAFTS.

Henry Trewhitt, of Newcastle-upon-Tyne, Esq., for improvements in applying the power of steam-engines to paddle-shafts used in propelling vessels. Enrolment-office, February 7, 1841.

These improvements consist in a new method of applying the crank-pin of paddle-shafts, so that one or both of the paddles may be disconnected or connected with the engine with great facility. For this purpose there is on each of the paddle-shafts a narrow cylinder, with a groove on its periphery, to receive a strap which is attached to the crank-pin that drives the paddle-shaft. The other end of the crank-pin is keyed into the crank of the middle shaft. In order to connect the paddle-wheel with the engine, the strap is made to bind tightly upon the narrow cylinder, and is disconnected by being loosened, in the following manner. A cross-head passes through slits in the end of the strap, and is fastened to a cushion resting on the narrow cylinder, and curved on its under surface so as exactly to fit. When the paddle-shaft is to be connected to the engine, the cushion is made to press upon the narrow cylinder by a wedge-shaped bar, which enters between the back of the cushion and the cross-head; this causes the strap to bind tightly upon the cylinder, and forms the connection required. On withdrawing the wedge-shaped bar, the strap becomes loosened and the paddle-shaft is disconnected from the engine. The claim is to the mode described of applying the crank-pins to paddle-shafts.—*Mechanics' Magazine.*

IMPROVEMENTS IN RAILWAY WHEELS, RAILS, AND CHAIRS.

Andrew Smith, of Princes-street, Leicester-square, and of Mill-wall, Poplar, Engineer, for certain improvements in carriage wheels, rails, and chairs, for railways. Enrolment-office, February 7, 1841.

The improvement in wheels consists in the application of a wrought iron tire, having a right-angled groove turned out in the middle, corresponding to the rail which constitutes the second part of these improvements. The depth of this groove is to be proportionate to the size of the rail, and forms a flange within the surface of the tire, tending to keep the wheel in its place upon the rail. The rails are square bars of iron, the sides of the squares being about one-third wider than the depth of the sides of the groove in the tire of the wheels, for the purpose of preventing the wheels from coming in contact with the chairs and sleepers. These rails are laid in grooves cut in wooden sleepers, and present one of the angles of the square upwards, corresponding with the angular groove in the tire of the wheel. The chairs are made of wrought or cast iron; they clip the sides of the rails in a dove-tail form; and are let into and bolted down to the wooden sleepers. The rails are each 12 feet long, by 2¼ inches square, and the chairs are placed in the middle and at the junctions of each rail. The claim is, 1. The right-angled grooves in the tires of the wheels of railway carriages, instead of an external flange.—2. The adaptation of common square bar iron, or of iron made in a square form, let into a wooden sleeper.—3. The chair, for connecting, and fixing, and fastening the rails.—*Ibid.*

IMPROVEMENTS IN LIME AND CEMENT.

Charles Smith of Exeter, Devon, builder, for improvements in the manufacture of lime and cement, or composition. Enrolment-office, February 27.

Claim first.—The mode of calcining lime or cement, or composition, by means of kilns, so formed, that the charge in the upper part shall be calcining, whilst the lower part of the charge is cooling; and in cooling, the heat therefrom passes to the upper part of the kiln.

The heat from coke ovens, furnaces, &c., is admitted into the kiln by flues which enter the kiln half its height from the ground, and the heat rising upwards calcines the upper part of the charge; whilst the lower part of the charge which has been calcined, is cooling, the heat arising from it assists in the calcination of the upper part. The lower part of the charge as it cools is raked out at the bottom of the kiln, and the upper part descending, fresh lime is added at the top of the kiln.

Claim second.—The mode of calcining lime and cements in retorts or ovens when in connection with a closed chamber, where the matters can be cooled before being brought into the atmosphere, and also the carrying off the gases or vapours, so as to apply them to a variety of useful purposes. The lime and cements are calcined in ovens which communicate with a closed chamber, in which the lime and cements, after being calcined, are cooled before they are brought into the atmosphere. The gases or vapours are carried off from the ovens by pipes provided with stop-cocks, into suitable vessels provided for receiving them.

Claim third.—The application of the heat of lime-kilns to the purposes of evaporating fluids in suitable boilers or pans, as herein described. The heat arising from the kiln is applied by means of flues to the heating of boilers or pans for evaporating fluids.

Claim fourth.—The mode of slacking lime in chambers with carbonic acid as herein described. The lime is slacked in a chamber, into which the carbonic acid arising from the kiln is admitted by means of valves communicating with the flue.

Claim fifth.—The mode of manufacturing lime by re-calcining it after dry slacking. The lime after being slacked as above described, is placed in the oven and again calcined.

Claim sixth.—The mode of manufacturing lime by partially calcining limestone in a kiln in order to convert it into sub-carbonate, and after cooling and grinding again to calcine it, whether separate, or combined with other matters, for making cement. This claim fully describes itself.

Claim seventh.—The mode of making cement by saturating sulphate of lime with ammoniated liquid, or other matters, as herein described. The patentee grinds sulphate of lime, or gypsum, into a powder, and covers the floor of the oven three inches thick with it. The oven is then closed, and the charge remains for four hours. It is then placed in a cistern and covered with purified liquor prepared from the ammoniated fluid formed in the manufacture of coal gas, commonly called gas water. When completely saturated it is spread over the floor of the oven and dried. It is then taken out, and a fifth part of slacked lime is added to it, after which it is ground and placed in the oven for the same time as before. It is then fit for use.

Claim eighth.—The combining lime and cements with ground calcareous matter, or stones, in substitution, or in aid of, silex, or other matter. The lime is mixed with ground calcareous matter, and burnt in the oven, after which it is fit for use.

Claim ninth.—The mode of preparing lime for use by applying soap, with or without glutinous matter, and also the method of using hot tools for finishing and polishing cemented surfaces. Two parts of ground marble are mixed with one part of fine slacked or ground lime, with the least quantity of water possible. This is done two or three days previous to using the same, but it is tempered once or twice a day with a beater or other tool. The patentee next takes one pound of soap, and dissolves it over a slow fire in about six quarts of water, occasionally adding two ounces of glue or other glutinous matter to the same, by which means the cement is rendered more tenacious. He takes the composition prepared as above, and adds to it the colour, to form the tint required for the ground colour, and brings it to the consistence for use by pouring into it the soapy solution, mixing it well, and applying it in the manner that stucco is at present done. When it is done a highly burnished hot metal tool is passed over the surface, which will unite the whole, and form a good polish.

Claim tenth.—The mode of preparing cement from lime, by means of oil and water, with or without other materials, as herein described. To any number of gallons of clean water add as much fresh burnt lime as will when slacked bring it to a semi-fluid consistency. When it is half slacked add as many quarts of oil as there are gallons of water, and stir this well together until the whole is properly mixed. Then strain it through a fine sieve, and when cool it is fit for use. It is applied in the same manner as when plastering with stucco.

Claim eleventh.—The combining aluminous earths and ground clinkers, or slag, or scoria, from the smelting furnaces; and the forming and burning of tiles thereof. Also the forming of tiles or burnt rough surfaces to be used in substitution of laths, to receive cemented surfaces as herein described. The tiles are made of three parts good aluminous earthy matter, mixed with one part of ground clinkers &c., from the smelting furnaces, and when properly tempered they are made, dried, and burnt in the same manner as roofing tiles. They are made rough on one side so that the composition applied may adhere freely in the same manner as the pricking up coat, thus serving the double purposes of laths and the pricking up coat.

Claim twelfth.—The mode of treating articles made of lime or cement, and calcareous stone or earth, by placing them in chambers with carbonic acid. The articles previously wetted with lime water are placed in the chamber mentioned in the fourth claim, and exposed to the action of the carbonic acid, by which they acquire great hardness.—*Inventors' Advocate.*

STEAM ENGINE REGULATOR.

Benjamin Hick, jun., of Bolton le Moors, Lancashire, engineer, for certain improvements in regulators or governors, for regulating or adjusting the speed or rotary motion of steam-engines, water-wheels, and other machinery. Entered at the Petty Bag-office, February 27.

This improved governor is applied to the throttle valve of steam engines, in place of the ordinary pendulum governor. The ordinary iron standard or frame of the governor, is placed as usual over the crank shaft of the engine, on which is fastened a bevel wheel that drives a pinion attached to an upright spindle or shaft; by this means a rotary motion is communicated to the spindle, which revolves in suitable bearings in the frame. The upper part of this spindle is cut into a screw, on which a bush or nut, having an internal screw, works; this bush, having two arms extending from it, to each of which is attached a vane: and the bush is connected to the throttle valve of the engine by links and a swivel, and connecting rods and levers, in the usual manner. If the crank shaft overruns or increases its ordinary velocity, it will cause the bush to rise up the spindle, and by means of the connecting rods and levers, partially close the throttle valve: on the contrary, if the crank shaft decreases its ordinary velocity, the bush will descend, and so open the throttle valve wider, in order to admit an additional quantity of steam to the engine. The patentee does not confine himself to the above, as the parts may be varied to suit circumstances.—*Ibid.*

APPARATUS FOR PREVENTING SHIPWRECK.

A few months since we gave an account of an interesting attempt made by Mr. Page, the superintendent of our Harbour Works, for simplifying Captain Manby's plan for relieving vessels in danger of shipwreck. It is with the greatest pleasure that we have to state that Mr. Page has *tested* the value of his efforts by saving a vessel, to all appearance, destined to inevitable destruction. About one o'clock P. M., of the 13th of February, the schooner *Leighton*, Jones, master, was seen making for this port, and driving with a heavy sea right for the north side of the harbour, where we have witnessed many a wreck with loss of life and property. The sea being at this time so heavy, and the boat, with the pier rope, being unable to get through, in consequence of the surf, the vessel struck on the North Bank. The situation of the vessel was now so critical, and the breakers surrounding so violent, that no boat attempting to relieve her could live. Under these circumstances, Mr. Page brought the twelve pounder belonging to the Harbour Works to bear upon her, and at the first discharge, succeeded in conveying a rope across the breakers, which passed fairly over her rigging. To this rope, a hawser was fastened by those on the pier, which, being hauled by the crew on board, sufficiently steadied her, and the result was the vessel was saved. We feel it our duty to give publicity to this circumstance, feeling perfectly confident that were it not for the rope conveyed by the carronade, she would either have been a wreck, or have received considerable damage. James Davies, Esq., the owner, was present, and seemed not a little pleased at the result of the first trial of Mr. Page's experiment.—*Carmarthen Journal.*

Since the appearance of the above paragraph, the above plan has been again adopted with complete success, but with such variation, as to give it additional value, by showing the versality of its application. On the 23rd ult., the schooner *Nanteos*, Griffiths, from London, appeared before this port, but the breakers were so high, that it was impossible for any boat to go out to assist her in. On this occasion the *carronade* was fired from off the pier, which carried the *plug* beyond the breakers,—this was picked up by the boat from the Nanteos, and a communication was immediately made with the shore, and the vessel came in without any difficulty.

The advantage of the *plug* over a *shot*, may be seen on occasions like the present,—had this been a *shot* connected with the line, it would have sunk, but the *plug* floated, and was easily picked up by the boat from the Nanteos.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Annual Report.

The Council of the Institution of Civil Engineers, on resigning the trust which has been confided to them during the past year, invite the attention of the Annual General Meeting, and of all who are interested in the progress of practical science, to the following report on the discharge of their various duties, and on the general nature of the proceedings of the past year.

The annual report of the council of several preceding years has dwelt in considerable detail not only on alterations in the ordinary business of the Institution, and on the introduction of measures which might tend to the convenience of the general body, but also on changes of a more important character, affecting the constitution and permanent stability of the Institution itself. The year which has now past has not been marked by any features of this nature. The principal duty of the council has been to carry out and persevere in the practice and regulations established during previous years, which have been found to contribute so much to the rapid growth and increasing value of the Institution.

But, though the past year may not have been marked by extensive changes or by the introduction of new regulations, it has been characterised by events of great interest, and the proceedings of the last session surpass in extent those of any previous year. The extended importance of the Institution has imposed an augmentation of duty and responsibility on your council, and they have laboured so to direct the affairs intrusted to them, that the discharge of those increased duties might be attended with a corresponding elevation in the character of the Institution, and that their successors in office may realize a still further progress towards that eminence which is already in some measure attained.

Among the various duties which devolve on your council, that of disposing and awarding the Telford premiums is of the highest consequence, and on the proper discharge of which much of the permanent success of the Institution will depend. The council, deeply impressed with this, have given their most careful consideration to the subject; they would direct your attention to the following notice of the premiums, and of the respective communications for which they have been awarded.

In the annual report of the last session, the council stated that it would be one of the earliest duties of their successors, to consider in what manner the benefits conferred by your member Mr. Parkes on practical science, by the communications then alluded to, could be most appropriately acknowledged; and the present council, concurring most fully in these sentiments, are of opinion that as no papers have hitherto been received by the Institution, exhibiting so much originality, labour, and ingenuity, in dealing with the facts presented to his notice, combined so essentially with practical utility, they are warranted in conferring on Mr. Parkes the highest honour which the Institution has in its power to bestow. They have awarded, therefore, the Telford Gold Medal to Mr. Parkes, for his communications on "Steam Boilers and Steam Engines," which are now published in the first and second parts of the third volume of the transactions. These papers and the discussions to which they gave rise, occupying as they did the attention of several of your meetings, together with the interest which they excited, must be fresh in the recollection of all who were present. It will, therefore, be unnecessary to dwell particularly on their contents; but, inasmuch as the highest honour of the Institution has been awarded to them, an honour which (it must be remembered) has been but once previously conferred, the council feel it to be a duty which they owe to the Institution, to themselves, and to the public, no less than to the author, to point out (as has been partially done in the report of the last year) some of the principal features in these communications, and the peculiar benefits which are thereby conferred on practical science.

These communications are the continuation of the labours of the author, which commenced with the paper on the "Evaporation of Water from Steam Boilers," published in the second volume of the transactions, and for which a silver medal was awarded on a previous occasion. The first communication, forming the subject of the present notice, relates especially to steam boilers, respecting which many well-ascertained facts had been collected; but previously to Mr. Parkes devoting his attention to this subject, no clear and connected view had been given of the various facts, or of their relation to each other, and to the circumstances under which they are exhibited. When so represented, it appears that the peculiar circumstances under which steam boilers are employed and their corresponding qualities and characteristics in respect of construction, proportion of parts, and practical management, present certain quantities and relations, which exert a peculiar influence over the results connected with evaporation; and these being clearly developed and understood, indicate correctly the character of the boiler. Certain definite quantities, relations, or exponents, with other facts of paramount importance, such as the effect of the element time, or the period of the detention of the heat about the boiler, and various actions independent of the temperature of the fire, and tending to the destruction of the boiler, are here for the first time pressed on the attention of the practical engineer. In the second communication, the author traces the distribution and application of steam in several classes of steam engines. In the execution of this task, he is led into a detailed examination of various important questions: the best practical measure of the dynamic efficiency of steam—the methods employed to determine the power of engines—the measures of effect—the expenditure of power—the proportions of boilers to engines—the standard measure of duty—the constituent heat of steam—the locomotive engine—the blast and the resistance occasioned by it—the momentum of the engine and train, as exhibiting the whole useful effort exerted by the steam—and the relative expenditure of power for a given effect, by fixed and locomotive non-condensing engines. The bare enumeration of the principal subjects which have been carefully analysed and illustrated by the facts applicable to each respective case, will give some idea of the magnitude of the task here undertaken; and when, in addition, is considered the elaborate and extensive series of tables exhibiting the results and analysis of the facts collected and used in the course of the inquiry, the council cannot but feel that a more laborious task has rarely been accomplished. A peculiar feature of these communications, and one to which the council would particularly advert, is, that they are not of a speculative character, but present a detailed analysis of authenticated facts.

This analysis consists in separating and ascertaining the various results, and in referring them to particular classes, so that they may be readily applicable in practice. The merit of instituting and recording a series of observations upon a scientific subject is universally acknowledged, but the reduction of such observations so as to form a standard of reference to which the practical engineer may appeal, is a task of far greater difficulty, and its execution of far higher merit. It is in this eminent rank that the council would place these communications of Mr. Parkes.

The description by Mr. Leslie of the Harbour and Docks of Dundee, was also briefly adverted to in the last annual report, as one of those communications on which the Institution sets great value. It consists of a detailed account of the progress of the improvements projected by Smeaton, Telford, and others, in part carried into execution by the projectors, and completed under the author's own superintendence since 1832. The illustrations of the projected and executed improvements with the plans, elevations, sections, and details of the works of the docks, gates, quays, cranes, and machinery employed, occupy 36 sheets of drawings. To the copious history and description of these works is added an extensive series of observations on the tides. The determination of these facts for different parts of the globe, is a question of the greatest importance in physical astronomy, and the council would take this opportunity of pointing out the essential service which may thus be rendered by the engineer to the cause of science by his recording the observations which *he* has pre-eminently the opportunity of making. For this valuable record of an executed work, the council have awarded a silver medal, and a copy of the life and works of Telford.

A silver medal and the life and works of Telford have been awarded to your associate, Robert Mallet, for his communication on the "Corrosion of Cast and Wrought Iron in Water." This communication presents features of no ordinary interest to the engineer. The comparatively recent introduction of cast iron for the purpose of piling, for wharfs, &c., and of wrought iron in the construction of vessels, has rendered the subject of the action of water upon iron of peculiar importance; the British Association have, from time to time, granted sums of money for making experiments on this subject, and Mr. Mallet having been engaged in conducting these experiments, has selected from the very extensive series of results obtained by him, those conclusions which may be of service to the practical engineer. The most valuable portion of this communication consists of elaborate tables, which exhibit the results of the action of clear and foul sea and fresh water at different temperatures upon cast and wrought iron. Such being the general nature of the experiments, the results to which they lead, or the effects produced, present several remarkable characteristics, and it is found that the corrosive action of water and air combined, produces, on the surface of cast or wrought iron, a state of rust possessing one of five distinctive features, viz. uniform—uniform with plumbago—local—local pitted—tubercular; or some two or more of these in partial combination. The practical results which may be deduced from these tables are of the highest value to the engineer, and point to considerations of the greatest importance; thus the upper and lower strata of water, of different degrees of saltness and density, coming in contact with the same mass of iron, a voltaic pile of one solid and two fluid elements is formed, and under such circumstances the corrosive action is materially augmented; hence it follows as a practical conclusion, that the lower part of all castings used in such situations, should be of increased dimensions. Similar results, the knowledge of which is of great importance to the practical engineer, such as the rapid decay of iron in the sewage of large cities, of the bolts of marine engines exposed to the bilge water, and of boilers containing hot sea water, are referred to actions due to similar physical principles. The protection which metals receive from paint, or from the presence of various alloys, so as to obtain a mode of electro-chemical protection, such that, while the metal iron shall be preserved, the protector shall not be acted upon, is also referred to similar principles.

The council have also awarded a bronze medal and books to Mr. Charles Bourns, for his communication on "setting out railway curves;" to Mr. Chapman, for his description and drawings of "a machine for describing the profile of a road," and to Mr. Henry Renton, for his description and drawing of "a self-acting Waste-board on the River Ouse."

The communication by Mr. Bourns is an application of simple geometry, leading to practical results. In setting out curves recourse has been had to various expedients, but Mr. Bourns, in the propositions contained in this paper, has shown that, by the use of the common chain, an offset staff, and table of offsets, he is enabled to set out curves of any radius and flexure, with a facility and precision not generally attained.

The description and drawings of a machine for describing the profile of a road, is one of several communications on this subject, sent in accordance with the notice of subjects for competition issued by the council. Many of the arrangements proposed by the author exhibit considerable ingenuity, and though difficulties may exist in their practical application, the council think this attempt may be of assistance to others, who may have their attention directed to the construction of an instrument for similar purposes.

The description and drawing of the self-acting waste-board on the river Ouse, being an account of an executed work, is one of those communications which the council are most anxious to encourage by every means in their power. The drawing and description furnished by Mr. Renton are highly creditable to the talents of the author, and deserving of some special mark of approbation.

The council have also awarded books to the value of five guineas to Eugenius Birch, for his drawing and description of the machine for sewing flat ropes, in use at Huddart's rope manufactory. The rope machinery of Captain Huddart was, some time since, one of the subjects on which the council solicited communications; on that occasion two valuable sets of drawings were communicated, the one by Mr. Dempsey, the other by Mr. Birch. The subject of the present communication was not included in either of the preceding, but Mr. Birch, desirous of availing himself to the fullest extent of the liberality of Mr. Cotton, the then proprietor of the machinery, and of carrying out the views of the council, has devoted much time and labour to placing in the Institution, an exact record of every thing connected with this interesting machinery.

Premiums of books have also been awarded to Mr. Maude, for his "Account of the Repairs and Alterations made in the construction of the Menai Bridge, rendered necessary by the gale of January 7, 1839," and to Mr. Andrew Burn, for his drawings of a "Proposed Suspension Bridge over the Haslar Lake." The council would point out these instances of the fulfilment of the engagements entered into on election, to the attention of the other graduates of the Institution, who have similar opportunities, but who have not hitherto kept their promises. It is the desire of the council to obtain an exact record of works that are projected or in progress, and such records are peculiarly adapted to compete for the Telford premiums; Mr. Maude and Mr. Burn, with proper permission, have availed themselves of the facilities afforded them, and the council trust that the premiums now awarded, and the marks of approbation here expressed, will stimulate others to avail themselves of like opportunities. The authors of such communications will thus most materially contribute towards promoting the interests of the Institution, and to their own qualification for future employment and advancement in the profession.

The Institution has received during the past year, many other communications of acknowledged merit, of which no mention has yet been made. To a few of them the council would now briefly advert, and especially to the last paper by Mr. Parkes, "On the action of Steam in the Cornish Single Pumping Engine," a communication of no ordinary importance and interest, either on account of its own intrinsic merits, as viewed in connexion with the past proceedings of this Institution, or the future pospects of this department of practical science. This communication, though intimately connected with those of the same author previously alluded to, growing immediately out of them, and depending upon the facts contained in them, is of a totally distinct character; being an attempt to explain, on theoretical principles, the action of the steam on the piston, and to unfold the real causes of the economy of the Cornish engines. This subject has occupied the attention of the Institution during the last four years, and the discussion first assumed a settled form during the session of 1837, on the receipt of the communication of Mr. George Holworthy Palmer, "On the application of Steam as a moving power, especially with reference to the reported duties of the Cornish and other Engines." In that paper the author, reasoning on certain data as to evaporation, and on the physical facts which involved the constancy of the sum of the latent and sensible heat in steam of all elasticities, and of the absorption of heat by matter on dilatation, came to the conclusion that no power could be gained by expansive working, and that, consequently, this could not be the *cause* of the economy in Cornish engines. This discussion was revived in the ensuing session by the communications of Mr. Wicksteed and Mr. Henwood, the former furnishing the first recorded experiment in which the water raised was actually weighed, the latter giving an extended series of most careful and detailed observations on the quantity of steam employed, the mode of its distribution, the duty performed by a given quantity of fuel, and the measurement of the water raised.

Taking for data the facts furnished by Mr. Henwood for the Wheal Towan, and by Mr. West for the Fowey Consols Engines, Mr. Parkes has analyzed the quantity of action obtainable from the quantity of water as steam consumed, and expanded to the extent used in those engines, and has found the steam's force unequal to the resistance overcome. After satisfying himself from various phenomena attendant on the working of these engines, that the amount of resistance opposed to the steam was not overrated, he was led to conclude that from the instantaneous and free communication effected between the cylinder and boiler of these engines, by the sudden opening of the large steam valves, a force must be transmitted to the piston, of a kind distinct from that of the steam's simple elasticity. This force he denominates the steam's *percussive action;* he adduces various proofs that this description of force has operated on the piston, and that it alone was equivalent, in the instance of the Fowey Consols Engine, to drive the piston through $\frac{47}{100}$ths of its stroke.

The author considers the effect produced on the piston of a Cornish Engine, by the sudden impact of highly elastic steam, to be similar to that obtained from water in the hydraulic ram. He has not in his paper entered on the consideration of the absolute amount of percussive force, which can be afforded by an aeriform fluid in motion—but has confined himself to the determination of the quantity of action, which he conceives to have been derived from that source in the particular engines examined. He invites the co-operation of others in instituting experiments on this subject, and the Council hope that the ensuing Session will augment the number of facts requisite for the complete demonstration and development of this view of the steam's action.

It is gratifying to reflect how much the present state of our knowledge is due to the discussions which have taken place at the meetings of the Institution. The Council look forward with great interest to the revival of these discussions, and for some valuable communications on this subject which are promised by Members who have daily opportunities of making observations and experiments on an extensive scale.

Among the other communications, the Council would briefly advert to that by Captain Basil Hall, on obtaining for Lighthouses all the advantages of a fixed light, by means of refracting lenses in revolution. It occurred to that distinguished officer that by placing a Fresnel lamp in the centre of an octagonal frame, having a lens inserted in every side, and causing the frame to revolve at a considerable velocity, a fixed or continuous light would be produced almost equal in brilliancy to the intermittent light from the same lamp when the frame revolved slowly.

Many curious effects are observed; thus, when the lenses are first set in motion the effect is a series of brilliant flashes; as the velocity increases, the light becomes more continuous—at about 44 revolutions per minute, absolute continuity is produced—and at 60 revolutions nearly the steadiness of a fixed light is attained. It would appear that the sensibility of the retina is affected by the succession of bright flashes, so that, judging by its intensity when seen through coloured glasses, the light would appear to suffer but little apparent diminution.

Another subject rather novel in its nature, but of considerable interest to the profession, on the "Application of Photography to the purposes of Engineering," was brought before the Institution, by your Member, Mr. Alexander Gordon. The facility with which this discovery may be applied to taking accurate views of buildings, works, or machinery at rest, renders it an object of great interest to Engineers; since by these means may be obtained the general dimensions of works, with perfect accuracy in a very small space of time, and by affixing a graduated scale to the objects to be copied, the photographic delineation would present the means of determining the dimensions of every part.

The Council cannot omit this opportunity of acknowledging the obligations which the Institution is under to Mr. Cooper and Mr. Cooper, Jun., who illustrated the preceding communication by exhibiting and explaining the apparatus requisite for the production of the delineations of photography.

The Council have to acknowledge the receipt of many valuable presents during the past year; and to record the liberality and zeal thus exhibited in the promotion of the interests of the Institution.

By the liberality of your President and of Mr. Burges, you are in possession of two portraits upon which every British Engineer must look with feelings of great pride and satisfaction. To the President you owe the beautiful portrait of Huddart, now suspended in your Meeting Room, and to Mr. Burges that of Smeaton, which adorns the walls of the Library.

The Institution has to acknowledge the continuation of the liberality of the Master-General of the Ordnance, of the Lord Lieutenant of Ireland, and of Colonel Colby, in transmitting the sets of Ordnance Maps as they are published.

The Council has also to acknowledge the receipt of some additional works from the library of the late Dr. Young, presented by his brother, Mr. Robert Young, whose liberality in making the Institution the depository of a large number of the works of that distinguished philosopher and benefactor to practical science, the Council of the preceding year had also to record in a similar manner. The Institution has also received a valuable set of Charts of the Coast of France, published under the direction of the French Government, from your President; a number of books from the Minister of Public Works at Brussels, collected by your Secretary during a recent visit to Holland and Belgium, when a communication was established between the Institution and the Ministry of Public Works of those countries; the Transactions of the Royal Institute of Naples from Colonel Cuciniello, through Mr. Albano; a valuable set of Crane Drawings from Mr. Leslie, and Drawings of the Carn Brae Stamping Engines from Mr. Sims, through Mr. Enys; some interesting models from Mr. Hick, a Pneumatic Mirror of his invention from Mr. Nasmyth, and a Radiating Stove Grate for the Library, from Mr. Sylvester; to these must be added the very numerous List contained in the Appendix to this Report.

The Institution has to regret the loss by death, of Mr. Francis Bramah, Mr. Oldham, Mr. Rowles, and Mr. Rickman; individuals distinguished for their attainments in professional and general knowledge, and endeared to the Institution by long association and deep attachment to its interests.

Francis Bramah was the second son of the late Mr. Joseph Bramah whose numerous inventions, perfection of workmanship, and genius in the mechanical arts, have rendered his name so widely and justly celebrated. The opportunities afforded to the son were ardently embraced by a mind of no ordinary powers, deeply imbued with the love of knowledge. Although his attention was in early youth more particularly directed to branches of minute mechanical construction, his acquaintance with the principal departments of professional knowledge and general science was very extensive. His attachment to the arts and to science was deep and sincere, and among many proofs of this may be particularly mentioned the valuable and essential services which he rendered to your late Honorary Member, Thomas Tredgold, both in his professional pursuits and in the prosecution and verification of his theories and calculations. Mr. Bramah being professionally engaged at Buckingham Palace, in connexion with some other engineers, difference in opinion existed and discussion arose, as to the true principle upon which the strength of cast-iron beams to resist stress and flexure ought to be estimated, and with the view of verifying the principles laid down by Tredgold, he instituted a very extended series of experiments, on the deflection and strength of cast iron beams. These he presented to the Institution, and they are published in the second volume of your Transactions.

Several important works were executed under his direction, among which the iron work of the Waterloo Gallery at Windsor Castle, the cranks, the lock-gates, and their requisite machinery, at the St. Katherine's Docks, and the massive gates at Constitution Hill and Buckingham Palace, may be particularly mentioned. Mr. Bramah was an early and deeply-attached member of this Institution; his constant attendance at the meetings, the information which he communicated, and his unwearied zeal as a member of the council, cannot be too highly estimated, and his loss will be deeply felt and regretted within these walls. The variety of his attainments, his refined taste in the arts, his amiable character and the warmth of his affections, had secured to him the respect and esteem of a most extensive circle of friends, by whom, as indeed by all in any way connected with him, his loss will be most deeply and sincerely felt.

John Oldham, the engineer of the Banks of England and Ireland, was born in Dublin, where he served an apprenticeship to the business of an engraver, which he practised for some time, but subsequently quitted to become a miniature painter, wherein he acquired some reputation. He pursued this branch of the arts for many years, but having a strong bias towards mechanical pursuits, he devoted much of his leisure time to the acquisition of that knowledge which was to prove the foundation of his future celebrity. In the year 1812 he proposed to the Bank of Ireland his system of mechanical numbering and dating the notes, and on this being accepted, he became the chief engraver and engineer to that establishment. The period of twenty-two years, during which he held this appointment, was marked by continually progressive steps of artistical and mechanical ingenuity. The various arrangements which he projected and carried out attracted great attention, and conferred considerable celebrity on the establishment with which he was connected.

The late Governor of the Bank of England, Mr. T. A. Curtis, had his attention directed to these important improvements, and under his influence the whole system of engraving and printing, as pursued in the Bank of Ireland, was introduced into the national establishment of this country, under the superintendence of its author, who continued in the service of the Bank until his death.

The ingenuity of Mr. Oldham was directed to other objects, especially to a system of ventilation, of which an account was given by the author during the session of 1837. Great versatility of inventive faculty, persevering industry, and social qualities of the highest order, were the prominent features in his character, and the success which attended his exertions is one of the many gratifying instances to be found in the history of this country, of talents and industry, destitute of patronage attaining to eminence in the professions to which they are devoted.

Henry Rowles, the chairman of the Rymney Iron Works, was educated in the office of his relative, Mr. H. Holland, the architect, on quitting which he entered into business as a builder. He was engaged, among other extensive undertakings, in building several of the East India Company's Warehouses, the Royal Mint, the Excise Office, and Drury Lane Theatre. He was an active Director in several docks, railway, and other companies, and finally became managing director of the Rymney Iron Works, in the active discharge of the duties of which office he continued until his death. The Institution owes to him the drawings of the iron works made by Mr. Richards.

John Rickman was educated at Lincoln College, Oxford, and graduated there; he subsequently devoted himself to literary pursuits, to political economy, and to practical mechanics. For some years he was conductor and principal contributor to the "Agricultural and Commercial Magazine." In 1801 he removed to Dublin, as Private Secretary to the Right Hon. Charles Abbot, then Keeper of his Majesty's Privy Seal in Ireland. Upon the election of Mr. Abbot to the Speaker's Chair in the House of Commons, Mr. Rickman continued to be his private secretary, and in 1814 he was appointed to the table of the House of Commons. He also acted as secretary to the two commissioners appointed by act of parliament in 1803, "for the making of roads and bridges in Scotland, and for the construction of the Caledonian Canal," and to the commissioners "for building Churches in the Highlands." The ability and energy which he displayed in the discharge and conduct of the duties of these laborious offices, for more than thirty years, in addition to his constant attendance at the House of Commons, called forth the warmest acknowledgments of public meetings held in the Scotch counties on his retirement, and various resolutions were passed expressive of the sense entertained of the unremitting exertions, and uniform and disinterested assiduity, with which he had promoted every object connected with the improvement and general prosperity of the Highlands and Isles of Scotland. The conduct of the affairs of the Highland Commissioners brought Mr. Rickman into constant intercourse with their engineer, Mr. Telford; an intimate friendship was formed between them, and Mr. Rickman completed and published the account of the life and works of that eminent man, which was but partially arranged at the time of his decease.

Mr. Rickman's chief work is the Census of Great Britain, in six folio volumes; he is also the author of numerous papers connected with statistics, having bestowed great pains in collecting and arranging the returns connected with education and local taxation. To this Institution he rendered very essential services, and whenever application was made to him in its behalf, was always zealous in endeavouring to promote its interests. The library was enriched by him with two copies of the Life and Works of Telford, and as the acting executor of Telford, he endeavoured to carry out, by every means in his power, the intentions of that great benefactor of the Institution.

Mr. Rickman's acquirements in every department of knowledge were accurate and extensive; to great quickness of perception, and memory of no ordinary power, were added indefatigable industry, undeviating method, and a sound critical judgment;—qualities which caused his acquaintance to be highly valued by the most distinguished literary characters of the day, and which, no less than the strict and scrupulous sense of justice and honour, which particularly showed itself in his considerate kindness towards all those with whom he was connected, will occasion his loss to be deeply regretted by a widely extended circle.

Address of the President.

Allow me to thank you for the compliment you have again paid me, by electing me your President for this current year.

The Secretary has reminded me, that I have been in the habit of addressing you on occasions corresponding with the present, but the very full, and I believe I may say, satisfactory Report of your late Council, has left but little for me to say on the business of the Institution. Your new Council have elected Mr. Manby for Secretary, Mr. Gibbon for Collector, and Mr. Hankey for Treasurer. We have the test of long experience in favour of the Collector and Treasurer, and although our acquaintance with your Secretary is shorter in point of time, we are all convinced that his whole attention and energies will be, as indeed they hitherto have been, devoted to the Institution.

Hitherto the increased number of our Members, and the attendance at the meetings during each year, have been commensurate with the growing importance of the Institution, and I have little doubt of the success of the present Session being still greater. We have under consideration several interesting subjects, to which some of our most active Members have paid great attention, and in which they have made important discoveries—these will form the ground-work of interesting and instructive conversation, or even, to use the language of a greater assembly, of 'debate,' but I trust that our discussions will continue to be conducted, as heretofore, with that good temper which makes even *debate* delightful, when the attainment of truth is the sole object. Truth will not bend one inch out of its right line, to accommodate false theory. He who tells us, that he "lost his patience when works were censured not as bad but as new," might be a very good poet, but in this respect at least he was no philosopher. One of our Vice-Presidents has presented me, within a few days, with a Report on the best mode of improving one of our great navigable rivers: this Report contains observations tending to level with the dust much that has been said by, I believe, all other Engineers, on the importance of tidal back-water. I know from experience that many theories which have, through their novelty or otherwise, appeared startling on the first view, have proved to be founded on truth, and have therefore superseded the old-fashioned notions. No class of men can be more devoted or bigoted to their opinions, than the Aristotelian philosophers were to their doctrine of syllogisms and *a priori* theories, which, though it had the authority of ages and names, was obliged to yield to the once-despised and even persecuted inductive philosophy of Bacon. Although, therefore, some Engineers may not coincide with the views expressed by our Vice-President, we shall do much good by examining impartially into the deductions he has drawn, at the same time carefully avoiding all personal considerations. A distinguished English Essayist after remarking that nothing denotes a great mind more than the abhorrence of envy and detraction, states, that the best poets of the same age have always lived on terms of the greatest friendship; and surely if this is the case with poets, who draw much upon imagination, Engineers, who have to deal with science and with facts, have less apology for excited feelings.

Without seeking in the recollections of a bygone generation for comparisons, we may congratulate ourselves that, although the number of Engineers has much increased, we are, I trust, without exception, *friends*: and I consider that our intimacy has been materially assisted by this Institution, where we have met, compared opinions, and rubbed off the sharp angles of professional jealousy or emulation, if any such existed.

Another valuable Member of the Council has, he conceives, discovered the true theory of the action of steam in the Cornish Single Pumping Engines, by which he accounts for their extraordinary economy. This theory, which is equally novel and ingenious, is now subjected to your examination and criticism, and I am sure that my friend Mr. Parkes would feel disappointed if his discovery were not to be submitted to that ordeal, in common with every similar subject of importance which is brought under the notice of the Institution.

While I congratulate the Institution on the increase of its Members, I ought at the same time to express my opinion, that from the number of young gentlemen who within the last ten years have studied for, or have entered, the profession, the supply is likely to be at the least equal to the demand; and to caution those who intend entering or are now studying for it, against confining themselves to the strictly professional part of the usual routine of education.

The Railways, both during the preliminary surveys and in their subsequent construction and management, in addition to other works of Engineering, have given employment to many. But the principal towns are already connected by Railways, or Engineers and Surveyors are now employed in projecting or executing lines where they are yet wanted. Is then the demand for professional gentlemen likely to *increase*? Is it not likely rather to *decrease*? Now certainly the number of Engineers or Students for Engineering is increasing. If we look at the number of students in the classes for Civil Engineering at the different Universities and Academies; the Universities of Edinburgh and of Durham; King's College, University College, and the College for Civil Engineers in London; we are led to ask, will this country find employment for all these? I freely confess that I doubt it. My object in what I have here said is, not to deter those who may already have resolved and have taken measures to follow the profession, but to advise them not to depend on this country alone, and so to direct their studies as to fit them for other countries also, where the field is not large enough to support men who are strictly and exclusively professional. For such, great countries only can find employment, and other great countries are educating their own engineers. To be fitted for going abroad to any part of the world, a man must be a tradesman as well as an engineer; he must furnish his *hands* as well as his *head*—and if he know more trades than one, so much the better; for he may have to direct in *all*, but *one* he ought to know thoroughly. Thus stored, all the world is open to him, and with the formation of new continents and colonies, and the improvement in the old ones, the engineer may insure independence. Not only in such countries, but at home also, his experience as a workman will prove his best friend and assistant in raising him to eminence, and make him feel that confidence in his own resources which has enabled so many engineers, whose name and fame stand high in the annals of the profession, to raise themselves from the millwright, stone-mason, and carpenter, to the highest grade. As a strong corroboration of the system which I recommend, you will observe the practical education given by each of these individuals to those of their family who are intended to succeed them. Let it not be supposed that I would undervalue the importance of science or of a scientific education, which is as essential to the Engineer as the knowledge of the principles of navigation is to the naval officer, but that I earnestly recommend *practice* also.

I hope to be excused this digression, but the great number of young gentlemen who, having been bred in Engineers' offices, apply to me for employment, which I cannot give them, or to be admitted as apprentices when I cannot in justice receive them, makes me feel very sensibly the importance of these remarks, and that it is almost a duty to give this publicity to my opinion.

To return to the Institution: I hope the attendance at the ordinary Meetings will be even better than that of last Session—that the Secretary's list which is regularly posted up, will have still a greater number of bright spots and a smaller number of black marks opposite the names of the Council, as well as of the Members, Graduates, and Associates generally. I do not name this as a complaint, for the attendance has hitherto gone on improving, that of the Council influencing the Members.

I have lately referred to the very great, and I fear, increasing, number of debts due to the Institution from Members and Associates, and still more from Graduates who were elected under a promise to send in an original communication or drawing, and I hope that the present Session will show a great reduction in the amount of these engagements. The fear of not producing something of sufficient value operates probably to overcome the desire which every gentleman, having made a promise, must feel in redeeming it. As an encouragement, let me refer such persons to the contributions by Graduates during the last Session; they will find that some of them required little inventive genius, but only the ability to record correctly what they have noticed on the public works in which they have been engaged, or which they have visited. To some of these, the Council have awarded premiums, and they esteem them valuable as recording details of works taken from measurements at the time of execution, thus forming an addition to our records, and making the Institution a deposit of "*works done*," which is one of its important uses; and I think no Engineer intrusted with public works would prevent Graduates having the opportunity of doing this for their own improvement, and for the benefit of the Institution.

The subjects for these papers, models, and drawings, are numerous,—I may almost say, innumerable. Of many of the great national manufactures of this country we have as yet no records in our possession, and until we possess them our stores will be imperfect. As an Encyclopædia gives a definition and general description of art, so should our Institution possess an original history, and drawings or models, as well as books, treating on every machine and manufacture connected with our profession.

Members of the Council during the last Session contributed liberally in books, and have set an example to the present Council. As a guide or specimen of the nature of the desired communications, the subjects for the Telford premiums have been varied and enlarged, but it is not to be understood that the subjects therein stated are to occupy exclusively the attention of Candidates, even for the Telford premiums. By thus enlarging the subjects and inviting papers, we may, I hope, look for an increased number of valuable communications, which it may press upon the Telford Fund to do justice to; I have therefore informed the Council that I have appropriated the interest of One Thousand Pounds, 3 per cent. Government securities, or Thirty Pounds per annum, which I request the Institution to accept, as my Annual Donation, to be applied as may appear best suited for the objects to which I have referred, or for other purposes conducive to the benefit of the Institution.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

March 8.—Jos. Kay, Esq., V.P., in the Chair.

Messrs. W. A. Burn, and J. J. Cole were elected as Associates.

The resolution of the Council was read on the Essay sent in for the prizes offered by the Institute, and it was announced that the medal had been awarded to Mr. Edward Hall, (late of Birmingham), for his Essay on Iron Roofs.

Mr. George Godwin called the attention of the Institute to the investigations in progress concerning the origin of several fires supposed to have been caused by overheating the pipes of hot water apparatus.—A discussion took place on the effects likely to be produced by the temperatures to which hot water may be raised under pressure, and Mr. Godwin was requested to ascertain and report to the Institute such facts as might be developed in the course of the inquiry to which he had alluded.

A paper was read on the Architectural Antiquities of Wisby, in the island of Gothland, communicated by John White, Esq.

Wisby in the 10th and 11th centuries was one of the most important commercial cities in the North of Europe, and is is said to have contained eighteen churches, of which there are still extensive remains. These buildings, which display the pointed arch, claim an antiquity greater than is generally conceded to that and other characteristics of the Gothic style, especially the church of St. Lawrence, built in the year 1046, St. Drotten in 1086, St. Peter in the same year, and St. Nicolas in 1097. These pretensions to the high antiquity of the pointed arch Mr. White supported by numerous citations from Klingvall, Pontanus, Jonas Coldingenses, and other northern historians. In the discussion which ensued, it was suggested that the original foundation of these buildings might have been preserved in history, and that they might have been rebuilt at a later period without any record of the fact having survived, an argument now fully admitted in several cases, (that of the Cathedral at Coutances for example), in which dates have been assigned inconsistent with the character of the architecture. But although Mr. White's paper may have been not altogether conclusive on this point, it drew forth the warmest acknowledgments of the meeting, as a most valuable accession of new matter to the stores of the architectural antiquary.

March 22.—Edwaro Blore, Esq., V.P., in the Chair.

Mr. Frederick John Francis was elected an Associate.

A letter was read from Professor Willis, Honorary Fellow, accompanying the copy of a curious and probably unique drawing (in England) of the profile of a door at Stephen's Church, Bristol, from a MS. of the Itinerary of William of Worcester, in the Library of Corpus Christi College, Cambridge. This work has furnished many of the technical terms used by the architects of the middle ages, but the drawing, which has been overlooked until the present time, throws new light upon several of them, especially on the term "corse," which has hitherto been a crux to antiquaries, and is omitted in some of our best glossaries.—Mr. Poynter first indicated the application of this word to the pinnacles of St. George's Chapel at Windsor, in the contract for vaulting the choir of that building, and its occurrence in the drawing in question applied to the flanking pinnacles of the doorway, seems to fix its meaning. It is probable however that the square shaft of the pinnacle only is intended, and that perhaps with reference to a peculiar use.—"A corse with an arch buttant" is mentioned elsewhere by William of Worcester, and in both the cases referred to, the shaft of the pinnacle serves as an abutment—at St. George's to the arch buttant (or flying buttress), and at St. Stephen's to the lofty pediment over the arch.

A paper was read on the Electrotype by Mr. G. H. Bachhoffner, Professor of Natural Philosophy, Queen's College, Guernsey, and Lecturer at the Royal Polytechnic Institution, who accompanied his experiments by several suggestions as to the mode in which practical architecture might be benefitted by this invention.

Mr. George Godwin in pursuance of the proceedings of the last meeting, detailed the results of the investigation into the cause of the fires at Manchester, conducted by Messrs. Davies and Ryder, at the instance of the Manchester Assurance Company, and embodied in their printed "Report on Perkins's system of warming buildings by hot water."—Mr. C. J. Richardson combated the report, and was disposed to question the accuracy both of the facts and conclusions. Even if it were admitted that ignition had been caused by hot water pipes, they were, according to his statement, not those of Perkin's apparatus, but of imperfect and bungling imitations.

The Institute then adjourned over the Easter holidays, the next meeting being appointed for the 19th of April.

THE OXFORD ARCHITECTURAL SOCIETY.

Feb. 10.—The Rev. Dr. Buckland in the Chair.

The following new members were admitted:—The Earl of Dunraven, Adare Mawr; Rev. the Warden of All Souls' College; Rev. Thomas Symons, M.A. Ensham; Rev. Henry Richards, M.A. Horfield, near Bristol; Thomas Stock Butterworth, Esq., Westbury, near Bristol; Rev. George Dawson, Exeter College; Rev. R. Greenall, Brasennose College.

The following papers were read:—

1. On Stanton St. John's Church, near Oxford, by Mr. Simpson, of Oriel College, illustrated by numerous sketches. The chancel of this Church is an interesting specimen of the transition from the early English to the Decorated styles towards the end of the thirteenth century. The east window is very remarkable and almost unique, the tracery being carried in straight lines through the head with foliations and good mouldings. Some of the original stained glass is preserved in the side windows, and some painting on the wood-work in the body of the Church.

2. On Montivilliers Church, in Normandy, by the Rev. T. W. Weare, Christ Church. This Church affords a curious specimen of the change from the Norman to the Gothic style, which was very scientifically traced by Mr. Weare, illustrated by several sketches, and by comparison with other buildings, particularly with Christ Church Cathedral.

3. On the restoration now in progress in the Temple Church, London, communicated by Sir Alexander Croke, through the President of Trinity College. This restoration appears to be conducted in the best taste, and is entitled to the cordial approbation and admiration of all lovers of architecture, and is the first real restoration of a Church to its original state, with its painted roof, stained glass windows, and polished marble pillars.

4. On the recent discovery, by the Rev. C. F. Watkins, at Brixworth Church, of the foundations of a round end to the chancel, from which it has been assumed that this was a Roman Basilica; and it is proposed by Mr. Watkins to rebuild the chancel in its original form and on the old foundations. The Chairman made some observations on the published account, and showed that the conclusion that this was a Roman Basilica was somewhat hastily arrived at, and scarcely borne out by the facts, since the round east end or apse was the common form of building Churches down to the twelfth century; and the workmanship of this Church is of so very debased a character as to be much more likely the rude imitation of a later age than genuine Roman work; nor does there appear to have been any occasion for a tower to a Basilica. It was also objected that to rebuild the chancel on the old foundations would perhaps invalidate the evidence, now so valuable, of its original form which these circular foundations afford. And a hope was expressed that measures might be taken to preserve these foundations in such a manner as to be accessible to the student of Architecture.

The Secretary mentioned that a local Society has been established at Bristol, according to a suggestion in the rules of the Oxford Society; and it was agreed that a copy of each of this Society's publications should be presented to the Bristol Society.

REVIEWS.

The Railways of England. By Francis Whishaw.

(Second Notice.)

Agreeably to the promise, we continue our extracts from Mr. Whishaw's work, the first which comes before us on this occasion relates to the Birmingham and Gloucester Railway.

The Ballasting on the London and Birmingham is thus described.

> The ballasting is of the width of 28 feet, and 22 inches in thickness. There are no less than seven different descriptions of ballasting; viz. burnt clay, burnt marl, gravel, sandstone, cinders, rock marl, and broken stone. The burnt clay and burnt marl cost from 1*s.* 2*d.* to 2*s.* 6*d.* per cubic yard; the gravel and sandstone from 6*d.* to 1*s.* 6*d.*; the cinders from 2*s.* 6*d* to 3*s.*; and the rock marl and broken stone (lias and oolite) from 9*d.* to 5*s.* 6*d.* per cubic yard. So many descriptions of ballasting, and so many different prices, cannot be heard of in the history of any other railway.

With regard to the Durham and Sunderland railway we find

> Some of the embankments on this railway are formed chiefly of small coal, which is, perhaps, the best material that can possibly be used for this purpose; the cost is stated to have been 9*d.* per cubic yard: except, however, in the largest coal distincts, its use is entirely precluded by the cost of carriage.

Of the inclines on the same line a longer account is given.

> To work this railway there are eight fixed engines: the first, or Sunderland engine, being of 70 horse power; the second, or Seaton Bank-top, 42 horse; the third, or Merton, 70 horse; the fourth, or Appleton, 83 horse; the fifth, or Hetton, 42 horse; the sixth, or Moorsley, 52 horse; the seventh, or Piddington, 85 horse; and the eighth, or Sherburn, also of 85 horse

power. Thus the united power is equal to that of 529 horses. The men employed in this department are nine engine-men, at 21s. a week each; twelve stokers, at 18s; and nine drummers, at 14s. each per week.

The first plane, ascending from Sunderland to Ryhope, is worked by three ropes; two being each 2450 fathoms in length, of $5\frac{3}{4}$ inches circumference, and weighing together 43,200 lb; and the third $4\frac{1}{4}$ inches circumference, and weighing 13,216 lb., and also 2450 fathoms long. The Seaton plane is worked by one $7\frac{1}{4}$ inch rope, 2,325 fathoms in length, and weighing 32,588 lb.; the rope is drawn out by the wagons descending by gravity. The Merton incline has two ropes; the one a 5 inch, 1250 fathoms in length, and weighing 8333 lb.; the other of $6\frac{3}{4}$ inches circumference, 575 fathoms in length, and weighing 6986 lb. The fourth plane is worked by one rope for the ascending, and by gravity for the descending wagons; this rope is of $6\frac{3}{4}$ inches circumference, 740 fathoms in length, and weighing 8990 lb. The fifth incline is also worked by one rope, which is of $4\frac{1}{2}$ inches circumference, 1425 fathoms in length, and weighs 7694 lb. The sixth plane has two ropes; the one being of the same length and weight as the last; and the other being 700 fathoms in length, $5\frac{1}{4}$ inches in circumference, and weighing 5121 lb. The seventh and eighth planes are each worked by a single rope, the length of each of which is 2450 fathoms; the size of the seventh being $5\frac{3}{4}$ inches, and the weight 21,600 lb.; and of the eighth, 4 inches, and the weight 15,120 lb. The whole weight of ropes, therefore, is 170,545 lb., or 76·13 tons. Mr. Blenkinsopp, the engineer of this railway, estimates the cost of these ropes at 40*l.* per ton, and their average duration about nine months. In this case, the annual cost for ropes on this line would be 2283·90*l.*, or 172·63*l.* per mile. At level road-crossings, the ropes run in channels properly constructed for the purpose. The rope-sheeves are of cast iron, weighing 28 lb. each, 12 inches in diameter and 7 inches wide; some of them being fixed in cast-iron standards, and others in wooden boxes, at intervals of 18 and 24 feet respectively. In curved portions of the line they are inclined to the horizon. At night the way is lighted by large fire-lamps, three at each bank-head.

The description of the inclines on the Dundee and Newtyle railway, will very appropriately follow.

The planes worked by fixed engines are the Law, the Balbeuchly, and the Hatton inclines.

The Law incline, which is 1060 yards long, the ratio of inclination being 1 in 10, is laid with three rails at top, four in the middle, and two at the bottom. It is worked by a forty-horse high-pressure engine, having a cylinder of $21\frac{1}{4}$ inches diameter; stroke 5 feet; rope-roll, 12 feet in diameter; the pinion on fly-wheel shaft having 32 cogs, and the spur-wheel on rope-roll shaft 97 cogs; the usual working pressure is 40 lb. on the square inch. The ordinary loads are from twenty to twenty-four tons, including a ballast-wagon of four tons, which always accompanies the train in its ascent, and is furnished with a break and clutches for the purpose of stopping the train in case of the rope breaking. The time occupied in the ascent is about six minutes. The counterbalance is of from ten to twelve tons weight. The cost of this engine is stated to have been 2750*l.* The rope is of $7\frac{1}{2}$ inches circumference, and weighs 8960 lb. The Balbeuchly incline, which has a single way only, is about 1700 yards in length, ascends at the rate of 1 in 25, and is worked by a 20 horse condensing engine; cylinder $26\frac{3}{4}$ inches, stroke 4 ft. 6 in., usual working pressure of steam $4\frac{1}{2}$ lb., the pinion on fly-wheel shaft has 48 cogs; rope-roll 12 feet diameter; and the spur-wheel on rope-roll 97 cogs. The usual load is about 16 tons; the time occupied in the ascent being six minutes. This engine cost 1600*l.* The rope is of $5\frac{1}{2}$ inches circumference, 900 fathoms in length, and weighs 7056 lb. The Hatton incline, which is also laid with a single way, descends to Newtyle, at the rate of 1 in 13, for a length of 1000 yards. It is worked by an engine similar to that for the Balbeuchly incline. The pinion, however, has only 31 cogs, and the spur-wheel 94 cogs. All the above inclines are straight; the sheeves are fixed at intervals of six yards. The consumption of fuel for the three engines is about 85 tons per month; the coals used are from Preston Grange, east of Edinburgh, and cost 10*s.* a ton delivered on the line.

The plan on the Edinburgh and Dalkeith railway, for stopping the trains in case of the rope breaking is ingenious.

Mr. Rankine calls it a self-acting stopper. It consists of two plates of iron, each having a double claw, the points of which are 15 inches asunder. These plates are each $13\frac{1}{2}$ inches in extreme length, 9 inches along the middle line of each, and 6 inches wide in the middle, increasing to 15 inches at the points of the double claw. The plates are $\frac{3}{4}$ of an inch thick, and $5\frac{1}{4}$ inches apart, secured together with $1\frac{3}{4}$ inches bolts. At the narrow end is a roller, 2 inches in diameter; in the middle is a 2 inch axle, to which an arm or lever is attached, this lever being connected at its upper end with the last wagon of the train. By means of the roller the stopper runs on one of the rails; and the lever, by which it is connected with the wagon, keeps the stopper at uniform distance from the train while in motion; but in case of the rope breaking, the train immediately runs back, raises the arm, and thus throws the stopper over, which causes the train to run off the rails.

On the subject of the Leeds and Selby earthworks, Mr. Whishaw approves of the mode of constructing the embankments.

Some of the embankments are of considerable height; and instead of being carried up with regular slopes, have their sides faced to a curved batter, the chord-line of which forms an angle with the base of about $67\frac{1}{2}°$. Where stone is plentiful, this is decidedly an economical mode of constructing embankments; for not only is the quantity of earthwork very much reduced, but there is also a considerable saving effected in the area of land required. The same observation will apply to the lower portions both of cuttings and embankments; for by carrying up retaining walls for about $1\frac{1}{2}$ to 2 yards in height, the quantity of excavation is much reduced, and also the area of land. Where stone-fence walls are placed on the top of the embankments, the whole width is 30 feet, and the clear width 27 feet.

We shall follow this by a description of the Manchester and Birmingham drains executed under the direction of Mr. Buck.

Besides the open field drains, circular perforated earthen drains are used to great extent in the cuttings. They are each 2 ft. 5 in. long, 14 inches in extreme diameter, and $12\frac{1}{2}$ inches in the clear. They are formed as iron water-pipes, with spigot and faucet; the clear diameter of the faucet, or larger end, being $14\frac{3}{4}$ inches, and the whole depth of the neck 4 inches.

The following observation is made by our author as to the use of bricks, while speaking of the Midland Counties railway.

The bridges almost throughout this line are built of red brick, the copings and strings being formed of hard-burnt brick earth, of the particular form required, as on the South-Eastern Railway. This plan might be advantageously carried out in many other districts where brick-earth is abundant.

Cowran Hill Cutting on the Newcastle and Carlisle railway hereafter described, was originally intended to have been a tunnel.

The strata intersected consist chiefly of clay, with intermixed veins of sand. The length is about one mile, the average depth 43 feet, and the greatest depth, 110 feet. The width of this cutting at level of rails is 26 feet. The sides are carried up with slopes of $1\frac{1}{2}$ to 1, and below the slopes is a retaining wall on either side, built of stone, 14 feet in height, 2 feet wide at top, and having a sufficient batter from the railway. On the top of each retaining wall is an open drain, which receives the water from the slope; and by means of vertical drains, which are connected with the main drains running under, and having the same inclination as the railway, the surface-water is entirely emptied into How Beck.

On the same line we have some interesting details as to the bridges.

There are several bridges of wood spanning the rivers. The chief one is that at Scotswood Road, being constructed on the skew principle. It is 30 feet on the square, and 50 feet on the skew span, and 30 feet high above the road. It is built of iron and stone, having five girders, weighing together 70 tons. The parapets are of rubble walling, coped with masonry. The whole presents a useful and economical piece of workmanship.

On the branch to Redheugh there is a bridge of singular construction, which carries a coal-way over the line. This bridge, which is of wood, and 3 ft. 4 in. wide, represents, as it were, the skeleton of lock-gates, consisting of four trussed portions, each hung folding, the meeting parts being furnished with small wheels, which run on iron segments when the gates are opened for the purpose of allowing the locomotives to pass.

Buchanan's Practical Essays on Mill Work and other Machinery. Re-edited by George Rennie, C.E., F.R.S., &c. Part I., 30 Plates and Text. London: Weale, 1841.

Robert Buchanan's Essays on Millwork are well known to every practical engineer, and still better as having been subsequently revised by Tredgold. To bring the progress of the art up to the present day, and to describe the modern improvements was a task yet to be attempted. This has happily devolved upon George Rennie, and it is almost superfluous for us to say that no better man could have been intrusted with them, to one who has cultivated with equal success both the theory and the practice, who is himself the author and inventor of so many of the innovations, which he will be called upon to describe.—Having contributed so much to enlarge the world of science, it was the least that we could expect of him, that he should come forward to do justice to his own works and those of his predecessors, the more particularly as he has in his own factory a museum from which to draw ample means of illustration.

The present Part is principally confined to the elementary matter, but the plates in it which refer to the forthcoming one give promise of most valuable matter. Among them are Bramah's Slide Lathe, his Lathe for turning Spheres, the Great Boring Lathe, the Wallside Drilling Machine, the Double Pillar Drill, the Key Grooving or Slotting Machine, Self-acting Nut-cutting Machine, machine for cutting the Teeth of Wheels, another for cutting the Teeth of Wood on Wheel Models, the Vertical Boring Machine for Cylinders, Planing Machine for Iron, Nasmyth's Planing Machine, a Punching Machine, Heck's Mandrel for expanding rings, &c.

Of Mr. Weale's exertions in this work we shall only say that both to civil and practical engineering he seems determined to afford equal benefit, those who remember Tredgold on the Steam Engine, will be prepared for a work got up with equal care.

The Laws of Trade. By Charles Ellet, C.E. Published in America. London: Wiley and Putman.

Some time ago we made long extracts from this author, explaining his system of charging tolls for goods; the work is now published in a collected form, and comes before us for recommendation to our readers. Mr. Ellet has exhibited great industry and acuteness in the investigation of a branch, as he says, but too little cultivated by engineers. The engineer who is best versed in the technicalities of his profession, will still be unadapted to the application of them, and the due discharge of his duties, unless he should have studied something else. The engineer is no bricklayer to put down a railway or canal just where he may be told, but he is an adviser who has equally to consult his own reputation in the stability of his works, and in the happy position of them for traffic. Mr. Ellet has conferred a boon on his profession, in calling attention to the laws which regulate traffic, and the revenue to be derived from it, and we hope that he will be imitated by his brethren here.

Tables of the Logarithms of Numbers, &c. By Edward Riddle, F.R.A.S., Master of the Mathematical School, Greenwich Hospital. London: Baldwin, 1841.

This is a cheap reprint of logarithmic tables from Mr. Riddle's work on Navigation, and as such we recommend it to our readers.

Practical Rules for the Management of a Locomotive Engine. By Charles Hutton Gregory, C.E. London: Weale, 1841.

Mr. Gregory is known as the Resident Engineer on the London and Croydon Railway, and some months ago he sent to the Institution of Civil Engineers a paper on the management of the locomotive engine, which since, by their permission, has been republished. It is made up in the form of a small manual, so as to go in the waistcoat pocket of an engine driver, and is printed in a good legible type. We equally applaud the design of the work and its execution.

An Experimental Inquiry into the Strength and other Properties of Anthracite Cast Iron. By William Fairbairn.

This pamphlet contains the continuation of Mr. Fairbairn's experiments on iron, and we refer our readers to it as containing some of the most valuable information as to anthracite, and the iron made from it.

ENGINEERING WORKS.

THE ARTESIAN BORING AT PARIS.

M. Arago who both as a member of the municipality of Paris, and as a "savant," has been one of the most active promoters of the Artesian Well of Grenelle, reported to the Academie des Sciences on the 1st ultimo, several details respecting the successful results obtained on the Friday preceding, which we think will be read with interest. Several Artesian wells on the right bank on the Seine at Epinay, Saint Denis and Saint Ouen, had given rise to the expectation of a supply to the city of Paris by the same means, which up to that time had been found attended with but a slight expense. The Municipal Council partaking in these hopes gave orders for the sinking of borings in the square of the Madeleine, at Gros Caillou, and at the Jardin des Plantes. The former was however abandoned nearly as soon as commenced, for reasons of a private nature, and the other did not succeed; nevertheless at the Jardin des Plantes the water had risen to within a few feet of the surface of the ground, essentially constituting an Artesian spring, although it held out no advantages beyond those of a common well, as in order to raise the water to the requisite height it was still necessary to have recourse to a pump. The fact of its not attaining a higher level at first appeared remarkable, but it was soon discovered that the sheet of water which fed the fountains of Saint Ouen and Saint Denis *cropped out* or came to the light on the banks of the Seine between Chaillot and Saint Cloud.—It was thus shown that this subterranean reservoir was subjected to a comparatively small pressure, and could give no encouragement to the establishment of Artesian foundations on the left bank of the Seine.

Notwithstanding this, the municipality entertaining views in accordance with those of a majority of geologists, did not give up the prospect of furnishing Paris with a supply of subterranean water. Already aware that several Artesian borings had been attended with immense success both at Tours and at Elbœuf, these being sunk into a stratum separated by the entire chalk formation from that of Saint Ouen, the council resolved in the year 1832 to make efforts to attain this second water-bearing stratum, and M. Mulot who had already undertaken several of the Artesian wells in the neighbourhood of Paris, entered into a contract to execute the Puits de Grenelle, which was commenced in the beginning of 1833.

Very nearly from the commencement of the undertaking unfavourable prospects became manifest. After perforating the tertiary sands, which at Grenelle are 41½ metres (136 feet) thick, and nearly as soon as the rods had reached the chalk, part of the rods detached themselves and fell to the bottom of the bore-pipe with great force. Considerable difficulties had consequently to be overcome, but these were soon surmounted, and the only result of this accident was a slight delay. In May 1837, when the boring had attained a depth of 380 metres (1246 feet 8 inches), a second and far more serious accident occurred—the chisel with which the ground was perforated, and a length of 80 metres (262 feet) of rods, again fell to the bottom. These weighed together (100 quintaux) five tons, a mass which it was absolutely necessary to raise again to the surface. It is already a serious matter to lift so considerable a weight when all the usual mechanical means are allowed to be brought into play, it may therefore readily be conceived that acting at a height above the object equal to thrice that of the towers of Notre Dame, and in a space having only a limit of a few inches, the obstacles are incalculable, and success almost a miracle. However, M. Mulot attained his object, he succeeded in tapping a screw on the head of the rods, and thus connecting another length to them, after 15 months of vain efforts, the chisel was at length brought up in August 1838, and the works proceeded with—they were, however, destined to be again interrupted before their conclusion.

The third accident occurred on the 8th April, 1840, the boring had then attained the rock chalk. Although the instruments were used with considerable dexterity, they made but slow progress. Suddenly however the chisel, the perforating end of which was extremely sharp, having been raised with great force, sunk at one stroke 26 metres (85 feet 3 inches) in the chalk. It then stuck so fast that no efforts could succeed in raising it, and had much force been resorted to, a fracture would have been the consequence, which would have led to a far more serious accident.—M. Mulot, whose inventive powers set a resolute face against every new difficulty, preferred setting the boring apparatus free by enlarging the hole on all sides, in which he was completely successful. The fourth accident was of less importance than the previous two, the chisel alone became detached, and its fall presented a new obstacle. M. Mulot at once saw that the remedy resorted to in the case which had occurred in May 1837 was no longer applicable, and the small size of the instrument led him to hope that he could pass on one side of the chisel. A cavity was formed in the side of the boring, and the instrument was forced therein. The works were then immediately recommenced, and no other detention occurred.

At last on Friday, 26th February, after 8½ years exertion, the rods suddenly sunk several metres,—the workmen perceived that all resistance had ceased, and after a few hours interval a majestic column of water 1691 feet in height (1847 English feet), the weight of which is equal to 53 atmospheres, rose from the bosom of the earth. Our globe having a temperature which increases as we descend, the water that flows from its interior assumes a warmth proportionate to the depth whence it rises. That of the Puits de Grenelle is at present 27°. 6 Cent. (81°.7 Fahr.) and it will increase as soon as the sides of the boring shall have attained the temperature of the ascending water.

The difficulties which have been described are not the only ones which this gigantic undertaking has had to overcome. The sides of the bore-hole are apt to crumble away, in which event the fragments falling in would fill up the hole and obstruct the working of the boring tackle. The strata which are perforated are also full of fissures, which might offer a vent to the ascending waters and cause them to be lost. These circumstances in connection with others which we cannot here enumerate, render it necessary to line the Artesian wells with a metal or wooden tube. This operation, which is not an easy one, even when a well is but some hundred yards in depth, increases in difficulty the deeper the works are carried. To effect it a tube of a certain diameter is first introduced, then a second one fitting into it succeeds, a third descends through the second, and so on;—these tubes exactly resembling those of a telescope. it is readily conceived that as they constantly diminish in diameter, unless they have been very nicely calculated, the aperture at last becomes too small for the free working of the boring rods. It is then necessary to lift all the tubes out and replace them by others of a larger diameter. At Grenelle it became five times necessary to remove the whole lining of the boring, and also each time to enlarge the bore-hole to allow of the introduction of larger tubes.—Let our readers then figure to themselves a cast iron column eight times as high as the towers of Notre Dame, which must be lifted out and replaced by another—they will then form a just conception of the patience, care and intelligence necessary.

The supply of water produced by the Puits de Grenelle is equal to upwards of four millions litres (880,387 gallons) per 24 hours, being nearly a gallon for each individual in Paris.—The waterworks of Gros Caillou Chaillot and the engine near the bridge of Notre Dame supply at the most, double this quantity: the well at Grenelle consequently, notwithstanding its first cost of 250,000 francs (£10,000), affords a cheap supply of water, more particularly if we bear in mind that this kind of fountain requires no repair.

Some persons are already raising doubts as to the continuity of the supply, resting their argument on the fact of some of the wells at Tours yielding less water at present than when first opened. They may, however, lay aside all uneasiness—if some of the wells at Tours have undergone a diminution, a greater number have increased in abundance, their supply having augmented by nearly one-third—and this discrepancy as it appears at first sight, is easily accounted for, by those who enter into all the facts of the case, being found to depend upon the more or less perfect lining of the borings. In the Province of Artois where Artesian wells which have existed upwards of 300 years are found, no diminution of the quantity of water produced has ever been observed—which by the way is quite natural, the sheet of water which supplies these having an almost unlimited extent—stretching as it does over a space of several hundred square leagues (1 square league = 5 square miles), the outlets to which (being these bore-holes) are almost unappreciable. This also shows us that greater numbers of wells may be sunk into the same stratum without affecting one another in the least. The outlay is however too great ever to lead us to expect much competition, and the perforation of the strata under Paris leaves us easy as to the future.

From an analysis made by M. Pelouze the water of the Puits de Grenelle is of a very good quality, and far purer than that of the Seine or of Arcueil, 100 litres only gave 14 grammes of extraneous matter (100 cubical inches gave $3\frac{1}{2}$ grains,) whilst a similar quantity of water from Arcueil, or from the Seine, yielded 17 grammes in suspension, and 46 in chemical combination, (100 cubical inches yielded 4·3 grs. troy mechanically suspended, and 11·6 grs. troy of chemical impurities).

An important question, and one the solution of which will not be completely attained for a few months, is the height to which the water will rise—referring to the levels where this water first percolates into the strata, we may hope that it will reach higher than the "Plateau" of the Pantheon—if this expectation be realized, all the various districts of Paris can be attained, and the improvements which the municipal council of Paris have long contemplated of supplying every habitation will be effected in a simple and economical manner, as it will only be necessary to make two or three other wells like that of Grenelle.

We cannot however be certain of the ascentional power of the water until the boring rods are withdrawn from the well, and the lining completed—some time is therefore still necessary before we know all the advantages which the perseverance of the municipality will have procured—a courageous perseverance which we cannot sufficiently praise, and which has had to encounter the lively attacks of many persons who fancied it impossible, that flowing water could ever be obtained by the means brought into play. The council however placed the greatest confidence in M. M. Eymery and Marie, the engineers charged by the "Ponts and Chaussées," with the superintendance of the supply of water to Paris, and who had first originated the proposal of an Artesian fountain —It was also supported by the opinions of MM. Elie de Beaumont and Arago, who never for a moment doubted of the final success of the undertaking, their confidence being based on analogy, and on a complete acquaintance with the geological conformation of the Paris basin.

We will endeavour to explain the reasons upon which they grounded their opinion :—

Paris occupies the centre of a basin, bounded on the west by the hills of Brittany and of La Vendée, on the south by the range which traverses the centre of France, and on the east by the Chain of the Vosges; this basin is filled up by successive layers, moulded as it were upon it, and fitting one into the other like those sets of cups we sometimes see inclosed in each other in order to occupy less room.

It will be clearly seen that each of these layers exposes its edges or outcrop to the day at greater or less distances from the centre. Those filling up the basin of Paris form three successive kinds of strata. The first or upper one called the tertiary formation consists of gravels and sands as found at Fontainebleau, of the gypsum which yields the plaster of Montmartre and St. Chaumond (plaster of Paris), of the limestone of Vaugirard and Montrouge, which supplies building materials for Paris, and lastly, of the plastic clay employed in all the potteries of the capital.—This last layer contains the sheet of water of St. Denis and St. Ouen. The second formation which immediately follows is the chalk which may be seen on the banks of the Seine from near Paris to Havre.

The third consists of various limestones connected with the Jura mountains, and consequently called the Jura formation (in England the oolitic).—The second water bearing stratum that of Tours and Elbeuf occupies the lower part of the chalk: it consists of a thick bed of sand inclosed in two very considerable layers of clay. The sand forms a kind of sponge which imbibes the water, and the beds of clay are as it were the sides of a pipe confining it, and whence it escapes whenever a perforation occurs. This stratum then, if it be continuous under the basin of Paris, if it exactly represent the cups we have described, must crop out at a certain distance from Paris, and form a kind of circle round it more or less regular in shape. This is actually the case. M. Elie de Beaumont has presented to the Academy a collection of samples of the sands belonging to this bed, and obtained at Cap la Hève near Havre, in the neighbourhood of la Fleche and Bonne Etable in the Sarthe, from Chateau la Valière in the Department of Indre et Loire, and from Allichamps near Vassy in the Haute Marne. All these are identical, and resemble the sand brought up with the water of the Puits de Grenelle. It is then evident to every one, as it long has been to geologists, that this sand forms a continuous basis to the Paris basin. Similar in shape to the bottom of a boat its sides rise to the day, whilst the centre is at a great depth from the surface. The waters falling on its edges or outcrop filter in and have formed a subterranean sea, occupying the entire width of the basin. Geology is thus established by the Puits de Grenelle as a positive science in the eyes of the whole world, and the conformation of the Paris basin made known with certainty.—*Le Constitutionnel, March* 4.

THE MAPLIN LIGHTHOUSE.

In the second volume of the Journal, page 38, we gave a description of the foundations of a Lighthouse to be constructed on a novel principal, by direction of the Trinity Board, under the superintendance of Messrs. Walker and Burges, the eminent engineers; the spot selected was the Southerly point of the Maplin Sands, which form the northern extremity of the Swin Channel, at the entrance of the river Thames. The foundations, as we before described, consisted of nine of Mitchell's patent mooring screws, with shafts of wrought iron 5 inches in diameter and 26 feet long, one was fixed in the sands in the centre, and the remaining 8 at the angles of an octagon 40 feet diameter, the screws were turned into the sand to the depth of 21 ft. 6 in., the top being then within 4 feet of the low water mark of a spring tide.

After the screws were fixed in August 1838, it was determined to leave them for a few months; from that period to June 1839, every change in the surface of the sand was observed, and notwithstanding that in the early part of 1839, there were several storms of more than ordinary violence, yet the screw piles stood firmly, and the sand at no time was lowered more than 3 feet. As a precautionary measure the engineers had constructed an open platform or raft of timber in two thicknesses, crossing each other at right angles, and bolted together at their intersections, which covered the whole site within the piles, and also extended some distance beyond them; round the exterior was raised a curb 18 inches high; over the platform was laid brushwood, and then about 200 tons of rough stone which sunk the raft on to the sand and prevented it being displaced, between the spaces of the platform and the brushwood the sand was allowed to work its way up, which soon filled the interstices of the stone. Very shortly after the whole of the platform and stone was embedded below the surface of the sand, which gave considerable support sideways to the screw piles, and formed a solid body for the water to wash upon. Nothing farther was done on the spot till the framing for the construction of the lighthouse was ready to be fixed in August 1840, when upon a careful examination it was found that the raft had completely settled down, and the piles as firm as the first day they were screwed in—it was then determined to proceed with the erection of the superstructure, which we shall now proceed to describe. The lower part consists of eight cast iron pillars 18 feet long, 11 inches diameter externally, and 9 internally, they are fixed at the angles of the octagon, and in the centre there is a similar pillar 22 feet long; the lower part of the pillars forms a socket, and is fitted over the top of the shafts of the screw piles to the extent of 4 feet, to which they are attached by adjusting screws of wrought iron; the upper part of the pillars also forms a socket 12 inches clear diameter, and 4 feet deep, into which are fixed the principal posts of the timber framing—these pillars are fixed inclining towards the centre. The pillars are tied together at top and bottom with wrought iron horizontal bars $2\frac{1}{4}$ inches diameter, fitted with collars and screw bolts; similar bars are fixed on the same level in a raking position to the centre pillar, by the aid of which the whole are firmly tied and braced together—the top of the pillars stands about 4 feet above high water mark of a spring tide. The timber framing was commenced by first fixing the centre post 21 feet long and 14 inches square, and subsequently those of the angles, 30 feet long, 12 inches square at the base, and 10 inches square at the top; they are tied together at the bottom by double horizontal tie beams, 12 by 5, and 27 feet long, and at the top 10 by 4, and 21 feet long; the ends are secured to the angle posts by wrought iron nut and screw bolts and iron knees. There are also raking braces from the angle posts to the centre $10\frac{1}{2}$ by 9, and 15 feet long; upon the tie beams are laid the flooring joists 9 by 3, the principal posts of the carcase framing are 6 by 4.

The interior accommodation consists of a living room 22 feet long, and a store-room in the upper part, and store-rooms for coals and water in the lower part. Thus far the erection was completed in October 1840, within a period of three months.

Above the living-room is fixed the lantern with a gallery all round—it is a polygon of 16 sides, 12 feet diameter internally, and 16 feet high from the floor to the roof; the principal part of the framing is of cast iron—the roof, the interior lining and floor are covered with copper. In the centre, raised upon a pedestal, is the beautiful apparatus of a second order of Dioptric light, made and fitted up, together with the iron work of the lantern, by Messrs. Wilkins and Son, of Long Acre. The height of the light above the mean level of the sea is 45 feet, and may be clearly seen from the deck of a vessel, in fine weather, upwards of 10 miles off in all directions. The light was first exhibited on the evening of the 10th of February last.

PLYMOUTH BREAKWATER LIGHTHOUSE.

A lighthouse is in course of erection upon the western extremity of the Breakwater, the first stone of which was laid by Admiral Warren, on the 22nd of February last, it was designed by Messrs. Walker and Burges, the engineers of the Trinity Board, in July last, and submitted to the Admiralty. Shortly after, their Lordships gave directions for its immediate construction. It is to be erected upon an inverted arch, the foundation of which is laid about 1 foot 6 inches below the level of low water spring tides, its centre at top is at the distance of 37 feet 6 inches from the western end or head of the Breakwater, and at the level of low water 195 feet. The diameter of the head of the Breakwater at the level of low water is 390 feet, and at the level of the top of the Breakwater 75 feet. The lighthouse is to be of granite 14 feet clear diameter, the centre of the light will be 55 feet from the top of the Breakwater. The interior will be divided into floors, forming a store room, a dwelling-room, a bed-room, and a watch-room. The lantern 12 feet wide and 7 feet 6 inches high, is to show a Dioptric fixed light of the second order, with mirrors; the south half to show a red light, to distinguish it from the coast lights, and the north side towards the Sound, is to be white. The stones of the lower courses are to be secured with dowels of slate, independent of a vertical and horizontal dovetail, the dowels are 18 inches long and 6 inches square at the centre, and sunk 8 inches into the lower course of stone, both ends are dovetailed and secured in their places by plugs in the upper, and by wedges in the lower stone. It is expected that the lighthouse will be completed by the end of 1842.

MERSEY AND IRWELL NAVIGATION.

We present in the accompanying reports of Mr. Palmer and Mr. Bateman the groundwork of a long discussion,* which has taken place at the Royal Victoria Gallery, Manchester. In this discussion which lasted for several evenings, Mr. Hawkshaw, Mr. G. W. Buck, Mr. Joseph Radford, Mr. W. Fairbairn, Mr. T. Fairbairn, Mr. Bateman, Mr. Thomas Hopkins, and other engineers took part. The proceedings are of particular interest on account of the important questions concerned in them, and of the public being thus brought to take a part in a professional subject. Of a debate of such length it would be impossible to give even an abstract, but we may mention some of the opinions put forward. Mr. Palmer is in favour of contracting the upper part of the river estuary, and forming the river as a funnel; Mr. Bateman is in favour of contracting the upper part, but opposed to interfering with the estuary; Captain Denham, opposed to contracting the estuary; Mr. W. Fairbairn, on Mr. Bateman's side; Mr. Buck, in favour of contracting the upper part, thinks the estuary might be partially contracted; Mr. Hawkshaw, of opinion that the upper part could not be improved without the neck of the estuary below Liverpool being contracted; Mr. Radford, Mr. T. Fairbairn, and Mr. Hopkins support Mr. Palmer. Thus in favour of improving the upper part of the river, the numbers are—

For, 7 .... Against, 1

With regard to the bay at Runcorn Gap,

For Mr. Palmer, 4; Mr. Bateman, 2; against, 2.

With regard to contracting the Mersey,

For, 4...... Partially, 1...... Against, 4.

Extracts from a "*Report on the Improvement of the Rivers Mersey and Irwell between Liverpool and Manchester, describing the means of adapting them for the navigation of Sea-going Vessels. By Henry R. Palmer, F. R. S., Vice-Pres. Inst. C. E.*"

At the time when inland navigation by means of artificial canals met with such extraordinary encouragement, the prevailing opinion was opposed to the use of rivers, chiefly on account of their currents, especially during rainy seasons. Probably this impression may have derived some of its strength, from the well-known bold expression attributed to the late Mr. Brindley, under whose superintendence the Bridgewater Canal was constructed. The advantages which that celebrated work exhibited over the natural line of navigation, *at the time* the former was constructed, were no doubt obvious, and many other instances might be cited, which would equally point out the superiority of an entirely artificial canal, over an *imperfect* or *ill-regulated* line of river navigation.

The actual distance, in a straight line, between the quay at Manchester, and the Company's Dock at Liverpool, is about thirty-three miles; while the length of the channel, in its natural course, between the same points, is forty-eight miles; the circuities amounting to no less than fifteen miles. Those circuities have, however, been reduced seven miles, leaving the present length of the line of navigation forty-one miles.

The width of the river at Manchester is 108 feet, at Warrington 140 feet, at Fidler's Ferry 170 feet, and at Cuerdly Point 650 feet.

From thence it rapidly widens to 3,500 feet. It is abruptly reduced to 1,200 feet at Runcorn Gap, and, within a short distance, is again widened to 4,200 feet.

* It was our original intention to have published the discussion, but it extended to such a great length that we were obliged to abandon our intentions. —Ed.

The widths continue to vary considerably towards the river's mouth, extending in one part to two and a half miles, and again diminishing to 3,300 feet at Liverpool.

The level of the highest tide, uninfluenced by a strong wind, intersects the bed of the river at Woolston, being a distance by the course of the channel of about 25¾ miles above Liverpool, and the bed of the river at Manchester is 49 feet above the level referred to. The first weir in the ascending direction is at Warrington, and the distance from thence to Manchester is divided into 10 pools.

The navigation of the river between Liverpool and the lock at Warrington is dependant upon the tidal water, and the whole of the remaining distance upon that derived from the uplands.

At Liverpool the spring tides rise	33 feet
At Runcorn	16½ „
At Warrington..................................	8 „

The lowest of the neap tides at Liverpool rise 23½ feet, and if the wind be strong in the adverse direction they do not extend to Runcorn. The depth of water at Liverpool with a high spring tide is 89 feet, but the bed of the river is rapidly elevated, and the depth during the same tide is diminished to 33 feet in a distance of 9½ miles.

A 33 feet tide at Liverpool occasions a 16½ feet tide at Runcorn; thus showing the bed of the river at Runcorn to be about 16½ feet above the level of low water mark at sea, assuming the line of high water mark to be level between the two places. This, however, is not strictly the fact, and will be hereafter the subject of explanation.

The river is subject to considerable land floods, which descend with great impetuosity, and overflow the banks, laying under water extensive areas of marshes. A land flood implies an accumulation of the water of drainage derived from a more than ordinary quantity of rain. The river channel being proportioned only to an average quantity, the surface of the stream is necessarily raised. But the accumulations that are so injurious, and which are complained of, are not to be attributed to any natural deficiency in the capacity of the channel, but to the permanent barriers or weirs that have been erected, which diminish the water space nearly three fourths, without any compensation having been provided.

The evil consequences of such circumstances are of far greater magnitude than has been supposed. It is well known that the water in its descent over the lands, washes down such loose soil as it is capable of removing; the same being conducted into the channel of the river, it is carried out to sea, if the moving power continue to be sufficient throughout the whole distance. The natural slope of the Mersey above the tideway is such as would occasion a considerable velocity of the water, but by dividing it into a series of pools, the velocity is, as it were, concentrated at the weirs, and the motion between them is much inferior to that which is required for removing the soil brought down by the rains. The cleansing of the channel is therefore exclusively dependant upon extraordinary quantities of rain from whence an increased velocity is obtained.

But if the weirs were altogether removed, it is obvious the river above the tideway would cease to be navigable: weirs of some kind are indispensable where the slope of a river is great, but it is equally clear, that they should be so constructed as to prevent the least hindrance to the motion of the floods.

Seeing that the fixed weirs contribute so largely and injuriously to impede the motion of the water, and therefore to elevate its height during floods, we find that a large proportion of it is made to pass over surfaces which are in no way benefitted, but which are damaged by it; while its use as a scouring power is altogether lost. While these effects cannot, perhaps, be entirely prevented, they may be greatly diminished, by so constructing the weirs that the impediment they cause shall have relation to the quantity of water in the river. If the weirs were properly made self-adjustable, according to circumstances, the bed of the river would be acted upon during longer periods, and therefore more effectually cleansed.

From the parallelism of the upper division, its bed is comparatively regular. The lower division is, however, of a contrary character; the extent of surface covered by the tides is such as to permit an effect upon their motion caused by the winds. The sands of which the bed is composed are therefore subject to a change of place, and hence the positions of the shoals are ever liable to variation.

From this circumstance the channel or line of deepest water varies also, and becomes divided in various places; so that instead of one permanent course, having a depth which is due to the natural force of the descending waters, several channels are formed, of which neither can be of the depth, that in a single channel, would be maintained.

There can be no doubt that the condition of a river is best for the purposes of navigation, when the deepest part is limited to one permanent and regular track. This can be effectually obtained only by causing the flowing and ebbing waters to act in the same lines; such a condition may not be practicable where the scale of the river is of so great a magnitude, that the motion and action of the water is influenced by winds.

The *principle*, however, should be kept in view, and should be approached as nearly as the means extend. A regularity in the outline or borders of the river is essential for the production of the effect required; and while the opposite banks of the Mersey remain as they now are, totally inconsistent with each other, we cannot hope for the improvement so much needed, and which is obviously within the power of art greatly to assist.

But to obtain that degree of regularity or parallelism which is required, certain excrescences in the area must be enclosed, by which it will become reduced. It is to the consequences of such a measure that the numerous opinions before adverted to were directed, and which have now to be considered.

It has been asserted that the open broad areas of the river at a considerable distance above Liverpool, are necessary for the maintenance of deep water towards the river's mouth; and it is thence inferred that if the area of the river towards the extremity of the tideway were diminished, great injury would be sustained towards the outfall.

The shoals are said to accumulate, and the depth of the channel diminish; and a great proportion of such effects have been attributed to the enclosures that have been made from the river in the upper part of the tideway.

In order to investigate the subject in question fairly, it is indispensable that the *source from whence the accumulations are derived be ascertained*, (*i. e.*) it must be known whether the materials which constitute the accumulations for the most part are derived from the sea shore, os whether they are brought down by the rains from the surface of the uplands?

That matter is brought from the interior and carried towards the sea, is a fact too well known to require more than allusion to it. But that the quantity so brought down and deposited in the bed of the river is scarcely perceptible, and that it does not produce any sensible injury, may, I think, be demonstrated in a satisfactory manner. It must then follow, that the accumulations complained of are *supplied from the sea*. I have confidence in being enabled to prove *that the great expanses in the area of the upper part of the river, are not only not beneficial to the outfall, but that they are injurious to it.*

If the accumulations were derived from the uplands in any sensible degree, the quantities deposited from time to time might be expected to bear some proportion to the quantities of rain fallen at different periods, because the quantity of matter brought down and conveyed through the upper division of the river to the tideway, must be regulated by the quantity of water which conveys it. But it is a fact long ascertained and known beyond doubt, that the accumulation of the sands in the vicinity of Runcorn (above and below that place) *is greatest when there is least water descending from the uplands.* Such is the amount of accumulation in *one dry season*, that it is felt by those who navigate the upper part of the tideway. It is then to be observed, that the accumulations progressively increase until the arrival of a land flood, on which occasion the excess that had become deposited is removed. The fact therefore is, that the quantities of accumulations in the river are inversely in proportion to the quantities of rain; and hence there is less deposit upon the bed of the river in the tideway when the greatest quantity of silt is brought down from the uplands. From this reasoning we may infer, that if there were no descending land stream, and if the whole area of tideway were a *mere bay*, the same would gradually silt up, and become dry land. Such would be the fact, and it will be shown that however extensive the receptacles for the mere tidal waters, they do not contribute to the preservation of the outfall.

The cleansing of the outfall is admitted by all to be dependant upon the force of the *outward* motion of the water. It must therefore follow, that the *inward* motion of the same (*i. e.* the flowing tides) will act in a similar manner, and bring with them such quantities of sand as they are capable of moving. The question then refers to the comparison of the *inward* with the *outward* forces. If the force of the ebbing tide do not exceed that of the flowing tide, it is evident that no greater quantity of sand can be carried out by the former than that which is brought in by the latter. If the ebbing water have an excess of power over that which flows, it is certain that a greater quantity of sand will be carried out than is brought in, and consequently *the depth must gradually increase*. But such, however, is not the fact, *although the ebbing tides are assisted by the waters from the uplands.*

From what has now been stated, I trust it will appear manifest, that the *effect* of the flowing tides in raising the bed of the river, exceeds that of the ebbing tides, and hence we may conclude, that *the depth of the channel is entirely and exclusively dependant upon the water derived from the uplands.*

Although I cannot imagine a doubt upon the fact just mentioned, the subject is of so much importance, that I must beg permission to make use of another argument.

If the deposits in the tideway were derived from the uplands, we surely ought to detect the fact by reference to the substance of which they are composed. I have obtained specimens of the bed of the river from various parts of it, and have found that the substance in the higher part of the tideway corresponds with that taken from below Liverpool. I have also found that the loose matter in the bed of the river above the tideway, has a different character. It is true that the strata of the district through which the river passes from its source is silicious, and, therefore, the debris partakes of that character; but in form it differs, and, as may be supposed, is mixed with various other substances, of which coal dust and soot may be taken as prominent ingredients. Now, the difference in colour of the general mass of specimens taken from the higher part of the river, especially that near Manchester, and that of the specimens taken from the neighbourhood of Runcorn and Liverpool, is such, that no doubt remains of their being derived from different sources.

Considering the character of the district through which the river passes, the immense consumption of coal on both its banks, and the prodigious quantity of loose coloured matter that must necessarily be washed into its stream, I certainly did expect to find some appearance of such matter in the sands in the vicinity of Liverpool, but although I employed a very high magnifying power, no such particles could be detected.

We have also abundance of examples, which prove most obviously, that with tidal rivers the raising of their beds is produced by the flowing tides, while the products of the land waters are *not observable until the tides have elevated the surface to nearly the height to which they rise.* The dimensions of the particles, a descending stream is capable of carrying, depends upon the velocity with which the water moves, and that velocity is determined by the slope of the bed. Most rivers appear to be progressively diminishing in depth, and hence we may safely infer, that their depths towards their outfalls were greater in proportion to the remoteness of the periods; their slopes must therefore have been greater, and the masses brought down proportionally so, and the debris derived from the uplands and deposited in the rivers must increase in dimension in proportion to the depth at which is is found. Although the common velocity of a river may be insufficient for the removal of gross particles, (say coarse sand,) it may be sufficient for carrying matter of a lighter description, and it is probable that all such light matter as arrives in the tideway of the Mersey, during the ebb-tide, is actually carried out to sea; but such as may arrive during the flood-tide, which at high water does not happen to be deposited on those parts of the bed over which a current passes when the tide returns, will *remain where it falls*. Now this can only happen where the sands have accumulated to a considerable height from another source before described, and it seems that the deposits from the uplands in the process now going on in the Mersey, are for the most part of the lightest description, and they are to be found only under the circumstances mentioned. All this reasoning is sufficiently supported by an examination of the soil of which the upper portion of the marsh land is composed, and may therefore be safely relied on.

The coasts of Surry, Kent, Suffolk, and a portion of Norfolk, are bordered by beaches of shingle, which are kept in perpetual motion by the action of the sea, and the component parts are continually seeking a place of shelter, and hence they enter and accumulate about the mouths of all inlets which have not the advantage of an opposing force, derived from a never-failing stream from the uplands. The direction of their prevailing course is determined by that of the most frequent or prevailing action of the waves, or breakers of the sea, and although a land stream be sufficiently powerful to maintain a passage to the ocean, yet such is the action upon the loose substances which compose the shingle, that their motion cannot be prevented, and the outfalls of the rivers become diverted into a direction parallel with the shore, unless such an effect be opposed by artificial means.

If, then, notwithstanding the existence of the constant aid of a land stream, it be difficult to retain an unencumbered outfall, much less can it be expected that a clear opening shall be preserved where such assistance is not available.

Leaving the operations of nature entirely free from control, it does appear that all inlets upon a coast invested by a shingle beach, and which are not preserved by the discharge of a stream from the land, must gradually diminish. The accumulating process is abundantly exhibited on the coasts alluded to. Dover, Folkestone, Rye, and Shoreham, afford excellent instruction upon the subject.

Nothing is more common than to assign, as the cause of decay in harbours, the enclosure of spaces which previously received the tidal waters, while the ordinary processes of nature are totally unheeded. I have never yet heard any reasoning which explains in what manner the abstraction of the tidal space can or does produce the effects complained of. If the flowing and ebbing forces be equal, the latter can only remove from a harbour the same quantity of matter the former may have deposited.

But upon careful examination of all the actions contained in the process, it will be seen that the flowing forces are the greatest, and hence we need seek no further for causes that produce the effects which we observe and lament.

But an approach to parallelism in the banks, is useful in another way: the tapering form of the opposite sides is known to contribute to the advancement of the tides towards the extreme points of their access. *The spring tides at Runcorn do now rise to a higher level than the high water mark of the same at Liverpool, while some neap tides, if opposed by the wind, will not reach that place.* In the latter case the tides at Liverpool return before the whole estuary has been filled, which would not occur if the area were to be diminished to its best proportion, and the sides properly regulated.

Very remarkable and interesting evidence on this branch of the subject is to be found in the Severn and Wye. The channel of the Severn is *funnel-shaped*, and the height to which the water rises increases with the distance reached; thus—

At Swansea a spring tide rises	30	feet
At the mouth of the Avon ..	40	„
At the New Passage........	50	„
At the mouth of the Wye ..	60	„
At Chepstow...............	70	„

Some portions of the rise at Cheptow may, however, be ascribed to the quantity of water descending from the mountains. These facts I have personally ascertained.

Now although the Mersey is of a different form from the Severn, yet it may readily be conceived that the momentum of this great body of water in the river below Runcorn, must, where the space is suddenly contracted, as it is at Runcorn Gap, cause a swell, and it therefore flows to a greater perpendicular height at Runcorn Docks than its natural level at Liverpool. This effect has, as before stated, been limited to spring tides, the neaps being contrary.

Mr. Bateman's Report to the Company of Proprietors of the Mersey and Irwell Navigation.

Gentlemen—In my recent investigation at Runcorn, as to the best means of improving the navigation there, I was led to the consideration of the general improvement of the river Mersey, and particularly of that part which lies between Runcorn and Warrington. A mode of effecting this in a manner which appeared to me likely to be beneficial to every party interested, suggested itself; and, in the belief that it is deserving your attention and consideration, I take the liberty of laying it before you.

The improvement of the river for navigable purposes is a subject of great importance to the proprietors of the navigation—to the town of Warrington, and to all who can participate in the advantages which may be expected to result. It is a subject which has frequently excited the most serious attention, and it appears recently to have been taken up with a spirit from which some practical and useful result may be confidently expected.

The river possesses within itself the means of very great improvement; and I am convinced, that, if these resources were sufficiently investigated and developed, no great length of time would elapse before we should see vessels of three or four times the present burden, unloading their cargoes at the quays of Manchester.

It is becoming of daily increasing importance, when we consider the vast impetus which must be given to the trade of Manchester and its neighbourhood, by the many important railroads which are now constructing—the great increase in the carriage of merchandise which may consequently be expected—the important benefits which the Inland Bonding Bill, if suffered to pass into a law, will confer upon the town, and the probable increase in the carriage from that cause also—with the necessity of carrying the facilities of inland navigation to the highest pitch of perfection, in order to cope with the powerful rivalry of callateral railroads.

The river, as far as the navigation extends, may be considered as naturally divided into three parts; from Liverpool to Runcorn; from Runcorn to Warrington; and from Warrington to Manchester.

The first is a wide and open estuary or inlet from the sea, navigable at high water of all tides, for vessels of considerable burden; and being from its nature susceptible of little improvement beyond the deepening and straightening of the channels. At high water, it is for the most part from two to three miles in width; but, at low water, the channel is generally not more than 200 or 300 yards. Upon this portion of the river, steamers ply regularly at every tide, between Liverpool and the various canals which enter the river near the town of Runcorn, for the conveyance of goods and passengers, and for tugging vessels; and it forms the utmost extent to which the natural navigation of the river, assisted by the tides, can be regularly and certainly made.

The second division forms the upper end of the estuary, separated from the lower part by a narrow strait called Runcorn Gap, where the opposite rocky shores approach to within about 400 yards of each other, projecting considerably within the limits of high water, both above and below. It is nearly a mile wide at the lower end, and terminates upwards in the ordinary channel of the river, which is probably about a hundred yards in width. It is only navigable at high water of spring tides, for vessels of more than 40 or 50 tons burden, and has been found so beset with inconveniences and difficulties, that the navigation of it has been nearly abandoned, artificial canals having been constructed inland, for the purpose of carrying on the communication.

The third portion lies above the reach and influence of the tides, and is strictly an artificial river navigation, having been rendered available for that purpose by locks and weirs, to the town of Manchester, and shortened and straightened in various parts by artificial cuts. It is only now, however, capable of being used by vessels ordinarily about 40 or 50 tons burden, drawing about four feet of water. The depths of the pools vary considerably, being in many cases 10 or 11 feet, and in others not more than four or five feet.

The navigation of this part is capable of being greatly improved, and may be adapted at a reasonable expense to the conveyance of vessels of 150 tons burden, or probably more.

Several bridges would prevent the passage of high-masted vessels; but all steamers, and such vessels as could sufficiently lower their masts, might make the entire navigation. This is perhaps now of less importance than it would formerly have appeared, as, from the rapid progress steam navigation has recently made, we may reasonably expect a very large proportion of the trade will be carried on by that means; while, to a considerable extent also, vessels expressly adapted to the circumstances of the navigation, would no doubt be constructed. A survey for the purpose of reporting the most effectual means of accomplishing the improvement of this part of the river is now in progress, and I have little doubt the report will be of a very satisfactory nature.

The main difficulty in the way of a general improvement to the town of Manchester, so as to take vessels of the size above mentioned, appears to exist in the inconvenient state of the navigation between Runcorn and Warrington; and it is to the improvement of that portion of the river that my attention has been particularly drawn, and to which I shall confine my observations.

Whether any definite plan for the improvement of this part, or the removal of its natural difficulties, has ever been proposed, I am not aware; but from the opposition with which all attempts to carry bridges over the estuary at or above Runcorn Gap have been met with, and from the jealousy with which any encroachment on the tideway has been watched, the general impression seems to have been that it was necessary to keep it in its present state,—that of an open unobstructed tidal river.

I rather think here has been generally a kind of vague idea, that some important plan of improvement would sometime or other be projected, and an apprehension that any alteration in the river might tend to prevent the accomplishment of the anticipated scheme; and, therefore, all parties have been particularly anxious to keep it in its natural and original state.

The examination I have made of the river with information obtained respecting it, and a careful consideration of all the circumstances connected with it—have led me, however, to the conclusion that so long as the river above Runcorn remains an open estuary, washed over by the tide, it will be impossible to effect (except at an enormous expense) any advantageous or permanent improvement.

The main difficulties under which this part of the navigations labours, are want of sufficient depth of water to carry vessels of any size up to Warrington, except during high spring tides—the short period of time during which it can even then be done—the circuitous and ever-changing channels—and the constant alterations of the sandbanks which are operated on and shifted both by tides and land floods.

To remove these difficulties—to secure a constant and unchanging channel of sufficient depth to allow nearly all vessels to go up to Warrington at any state of the tide, that can reach Runcorn Gap—to give a longer period of time during which the navigation can be made—to do away with the danger and annoyance of being neaped on sand banks, as at present—and to do all at a reasonable and warrantable expense, and so as not to injure the navigation of the port of Liverpool, nor injuriously to affect any other interest, is the end to be desired, and the end which, I hope to be able to show, the plan I have to suggest will be sufficient to attain.

I have mentioned, that the width of the river at Runcorn Gap is about 400 yards, and it is bounded at each side by precipitous rocks. The tides here, even when pressed by strong winds, never rise more than 20 or 21 feet; and at low water the greatest portion of the channel is dry, there being little more than a few feet of water in any part.

The plan I have to propose is to throw an embankment across the river at this place, with proper and sufficient locks and flood gates to admit and discharge the tidal waters under certain regulations.

Were the question merely confined to the best means of improving the navigation from Runcorn upwards, without reference to any effect to be produced below, a simple embankment or weir, with self-acting flood-gates to admit and impound the high tide water, with such locks as might be necessary for the navigation, would be all that would be required; for by that means you would have a pool constantly filled, deep enough to float vessels to and from Warrington, at every hour of the day, drawing 12 or 14 feet of water.

But it becomes a question as to how far the obstruction to the flow of so much tidal water, with its scouring effect upon the channel during ebb tide, would affect the entrance to the port of Liverpool, or the navigation from Liverpool to Runcorn; and I am of opinion, that, unless measures were adopted to prevent it, an embankment only, which would constantly keep up the water, would have an injurious tendency.

To prevent this, and for the purpose of always maintaining a deep channel (and I believe in a more effectual manner than can now be done), I would propose the construction of sufficiently capacious flood-gates to discharge at half-ebb of spring tides, when the most effectual scour is going on, the whole body of water which is impounded, refilling the pool at the next tide.

Having thus stated generally the nature of the plan, I will proceed to explain it more in detail, to point out what I consider its advantages, and to investigate the objections which, it appears to me, may be urged against it.

The average height of the tides at Liverpool over the old dock sill, is about 15 feet,—the highest being about 21 feet, and the lowest 10 feet. These measured from low water are respectively about 33 feet and 23 feet.

An 18 feet tide at Liverpool, being an average spring tide, and about 30 feet in the river, will rise about 15 feet at Runcorn, and 8 feet at Bank Quay, near Warrington.

Such a tide will allow vessels drawing 13 feet to reach Runcorn, and such as draw 8 feet, about 100 tons burden, to go forwards to Bank Quay. A neap tide will scarcely bring a vessel drawing 8 feet to Runcorn, and it will carry nothing at all (but a flat, perhaps) to Warrington.

The average of vessels drawing the greatest depth of water which reach Runcorn, may probably be taken at 10 feet, varying from 100 to 200 tons burden; and this size includes nearly all the coasters, those engaged in the Irish provision trade, and steamers.

At present, such vessels can only get forward to Warrington, at the very highest spring tides, perhaps two or three times in the course of the year; but, by the plan suggested, they will be able to do so as often as they can reach Runcorn; and, when once at Warrington, all steamers, and such vessels as can lower their masts, may go on to Manchester, when the necessary improvements on that portion of the river are effected.

It seems that the difference in the depth of water between Runcorn and Bank Quay at high tide, is about 7 feet. Of this I am inclined to think 4 or 5 feet is attributable to the natural declivity of the ground, and the remaining 2 or 3 feet to the fall in the surface of the flood tide, which, I apprehend, never attains the same relative height at Bank Quay as at Runcorn. If I am right in this conjecture, the effect of an embankment will be as follows:—

A tide rising 15 feet at Runcorn will (as I have shown before) give, as the river is at present, 8 feet of water at high tide at Bank Quay; but, supposing this tide to be retained at Runcorn, and prevented from flowing back, the water would gradually level itself, by rising at Bank Quay, and falling at Runcorn; and if the width of the river were the same from one end to the other, and the difference to begin with was 3 feet, it would rise 1 foot 6 inches at Bank Quay, making the depth of water there 9 feet 6 inches, and fall the same amount, 1 foot 6 inches at Runcorn, reducing that depth to 13 feet 6 inches. As the river, however, is much wider at the lower than the upper end, the fall at Runcorn would be less than half the amount of the difference, and the rise at Bank Quay more than half,—making the depth there probably 10 feet. Suppose further, that the land or river water was allowed to flow into the pool, so as to raise the entire surface to the level of the original tide, 15 feet at Runcorn, which would occupy about a day and half, there would be a depth of 11 feet at Bank Quay; and, supposing the river is then allowed to flow on through the pool as usual, we must add the fall or declivity in the surface necessary to give it the requisite velocity;—this would be about 2 or 3 inches in a mile, and the distance being, say 7 miles, we should have an additional depth of from 1 foot 2 inches to 1 foot 9 inches to add, making the total depth at Bank Quay from 12 to 13 feet, being a gain of from 4 to 5 feet depth of water.

As this depth is 2 or 3 feet more than is required to float a vessel of 10 feet draught, it will be sufficient if we retain a tide rising 12 or 13 feet at Runcorn, or 15 or 16 feet over the old dock sill at Liverpool. It is of importance to mark this, as you will perceive by observations I shall have to make upon the scouring power I propose to substitute.

Laying aside for the present any consideration of the effect which may be produced below Runcorn, I can see no objection which can reasonably be urged against it, but the possibility of the river gradually silting up, by the deposition of material brought down by floods. The mode I have to suggest of scouring out the channel, will, I think, almost entirely remove the possibility of this being the case, in the navigable channel; but, even without that, I do not think it would have such an effect. The river would maintain its course and current along the deep, depositing whatever it might bring down on the sandbanks and shallows at each side, where there would be little or no current, thereby gradually raising and preparing for agriculture purposes, an unprofitable waste of sands, washed over now by every high tide by which they are frequently removed and carried into the deeps.

I know many instances of rivers maintaining a distinct course through large lakes; but two, which must be familiar to nearly everybody, will be sufficient to mention. The Rhone through the Lake of Geneva, a distance of 37 miles, and the river Bann, for 18 miles through Lough Neagh, in Ireland; each river maintaining a deep and distinct channel through the entire length of lake. The Rhone, however, and, I have no doubt, the Bann also, forms a delta on first entering the lake.

I think that, generally, the channel would be improved; and if deposit was to take place in the upper part of the estuary, where the river would first enter into comparatively still water, it might easily be removed by dredging.

The benefits to the town of Warrington, in particular, must be too obvious to need any remark. The Sankey Canal would obtain a much better entrance than it has now; and the Mersey and Irwell Company would have so much of their navigation permanently improved, and rendered available for a large class of vessels, which they may then take on to Manchester.

We now come to consider the effect which may be produced upon the channel below Runcorn Gap, and upon the entrance to the port of Liverpool.

It would be of little use to suggest plans for the improvement of the upper part of a river, if the mouth were to become so choked up that no vessels could enter; and, in the maintenance of a good entrance to the port of Liverpool, the Mersey and Irwell Canal Company is as vitally interested as any other party can be.

I hope to be able to show, that, so far from the suggested works being likely to do injury, they will assist in scouring out and deepening the channels all the way out to sea.

Much evidence was given, in the trial betwixt the Old Quay Company and the corporation of Liverpool, in 1827, relative to the scour of the river; and from that it appears, that the most effectual in cleansing and deepening the channels is that produced by the ebb tide, when about half down, and the land floods: the latter losing much of their power, however, in the lower part of the estuary.

As this accords strictly with my own observation, and the information of those connected with the river and daily navigating it, I have no hesitation in taking it as the fact.

It appears, then, that the early part of the ebb tide is of little service in improving the navigable channels of the river; and indeed this must be obvious, when it is considered that the water is then running with pretty nearly equal velocity over the whole bed of the river, and removing probably more sand from the banks into the channels than it carries out of them.

Now, if any considerable portion of the water that is thus wasted, as it were, could be retained until the tide was half down, and then set at liberty, it would have the effect of keeping up the river for some hours longer at the most effectual scouring point, and be thus enabled to work deeper into the channels, and carry the sand or silt removed further out to sea.

I think I can make it clear, that this will be the result of the scheme proposed during spring tides; and that, during neap tides, or whenever prevented from flowing beyond the gap, the water will rise higher at Runcorn than it can now, and consequently increase the velocity of the ebb. In either case there will be a strong tendency to improve the channels both above and below Liverpool. The estuary will contain, to begin with, nearly if not quite as much tidal water as it does now, and under regulations which will render it of more effectual service, while eventually the improvement of the deeps will enlarge its capacity.

The upper part of the estuary and river, from Runcorn Gap to Howley Weir, at Warrington, containing at high water of spring tide (including Halton Marsh) about 1,300 acres, is about 1-17th of the entire area of the estuary above Rock Perch. In spring tides, at high water, it contains from 1-25th to 1-30th, and in neap tides from 1-40th to 1-50th of the whole body of water.

Mr. Giles, in his evidence for the corporation at Lancaster in the suit before referred to, calculates the contents of the river at ordinary spring tides, from Runcorn to Warrington Bridge, at 10 1-3 million tons, or about 13,733,000 cubic yards. As a 15 feet tide at Runcorn falls 8 feet to half ebb, considerably more than half the quantity has flowed out before that time, so that the remainder, say six million cubic yards, is the only portion that is effectually employed in scouring the deep. As this is six hours in ebbing out, the velocity becomes so trifling towards the end as to be ineffectual.

In neap tides the effect is proportionably less.

The late Mr. Nimmo, in his evidence for the company in the same cause, gives from actual measurement the ordinary flow of the river above Warrington, and the depth of a very heavy flood over Woolston weir, from which I have been able to ascertain its volume.

From Mr. Nimmo's observations, the fair average of the ordinary quantity may be taken at 40,000 cubic feet, or 1,480 cubic yards per minute.

The flood appears to have been about 580,320 cubic feet, or 21,493 1-3 cubic yards per minute, or nearly one million and a half yards in a hour,—probably nearly equal to the tide at half ebb. It was running at the rate of 113 yards in a minute, or nearly four miles an hour.

It is half ebb at Runcorn rather earlier than at Liverpool; and from half ebb to the commencement of the flood tide at Liverpool, there is about three hours. It is during this period that I would propose to discharge the water which would be retained above our embankment.

I have stated, that a 15-feet tide at Runcorn has fallen eight feet, or to half ebb. If flood-gates were constructed in the bank, 60 yards in length, 8 feet in depth, and opened at half ebb so as to obtain an average pressure of 8 feet to the bottom of the discharge, the quantity discharged in the three hours would be nearly six million cubic yards, or about the whole quantity now contained in the estuary with a similar tide at half ebb, and requiring six hours to flow out.

If the discharge sluices occupied 100 yards in length instead of 60, being then 1-4th of the width of the gap, the discharge in the three hours would be more than nine millions and a half cubic yards, being half as much again as all the water now left in the estuary at half ebb, and more than 2-3rds of the whole contents measured at high water of spring tides, and nearly equal to the whole quantity at half ebb added to three hours of such a flood as Mr. Nimmo mentioned. The discharge would be at a velocity of 10 feet per second, or nearly seven miles an hour, and would, after mixing with the other water, maintain a velocity of three or four miles much greater than the mean velocity after half ebb at present.

There cannot be a doubt, I think, that, under such regulations, the scouring power would be greatly increased; and, while below the gap, the direct force of this power would be employed in deepening the channel and carrying out the sand and silt to sea, the velocity of the current above the gap would be so much increased and confined to a particular direction, that the channels there would also be deepened, and any casual deposit carried out; so that, independent of other improvements, the channels of the whole river would be improved from Warrington to the sea.

After these discharges the pool might be refilled at the next tide, or whenever the tide rose more than 13 feet at Runcorn. At the lowest spring tides, for three or four days together, and at the highest, for seven or eight days together, perhaps twice each day, but at any rate every alternate tide, much less frequently than this would, I am satisfied, be found amply sufficient.

The next point is, that, by the tides being prevented from flowing beyond Runcorn Gap, they would rise higher there, and, by thus attaining a greater head or elevation, which will be another advantage besides, would produce an increased velocity in the ebb.

The tide flows past Runcorn at the rate of five miles an hour; and if stopped there by an embankment, and prevented from flowing up to Warrington, and filling that part of the estuary, the momentum, which impels it forward for an hour after it has turned at Liverpool, would cause it to impound in front of the embankment. From calculations I have made, I am disposed to think that the additional rise would probably be about 1-20th of the total depth of water, or from four to nine inches, according to the height of the tide. This amount, small as it appears, would be of service in neap tides.

I have now, I think, gone over the main points which appear to me materially to bear upon the question; and I hope I have succeeded in explaining them in such a manner as to render them intelligible, and enable you to understand my views.

If I am any thing nearly right in the data I have taken, and the conclusions I have drawn from the calculations I have made, the advantages in every point of view must be considerable, nor are these advantages confined to the navigation only; the adjoining landowners may reclaim a large portion of the land above Runcorn, which is now covered at high tides; a good road, with draw or swivel bridges over the locks, may be formed on the top of the embankment, and thus join the two counties of Lancaster and Chester in a very much superior and more convenient manner than is now afforded by the dangerous and inconvenient ferry. Even a railway viaduct, if carried at a sufficient height, would then be no objection; and many miles of railway travelling might be saved to the London and Liverpool traffic, by crossing here, and joining the Grand Junction at Prestonbrook.

It only remains to explain shortly the kind of works which would be required.

The width of the strait at Runcorn Gap is about 1,250 feet. The bed of the river consists of about 35 feet of rock on the Cheshire side, dry at low water; about 715 feet of sand and silt in the middle of the river, extending, I believe, to a considerable depth partially dry at low water; and about 470 feet of rock, all above low water, on the Lancashire side. The rock extends inland on each side, rising considerably, particularly on the Cheshire side, above high water level.

I would propose to construct two sea locks *in* the rock on the Cheshire side; one 180 feet by 40 feet, and the other 120 feet by 30 feet, with hydraulic gates, so that they may be self-acting, and used for the purpose of scouring. In the rock on the Lancashire side, I would recommend the construction of the self-acting flood-gates, and between the limits of high and low water there is ample space for *ten*, with 30-feet clear water openings in each; the gates to be revolving on an upright axle, placed a little on one side of the centre, so that one leaf of the gate should be rather larger than the other. The gate, of course, must open only one way, the larger half turning *up* the river: when, therefore, the flood tide rises higher than the surface of the water on the upper side of the gates, the pressure being greater upon the larger leaf than the smaller, the gate opens, and the water is freely admitted. When the tide has reached its greatest height, and begins to fall, the pressure is then reversed, and the gates close, retaining all the water that has flowed past the embankment. To open the gate, and discharge the water *en masse*, various methods might be adopted. The simplest, perhaps, would be to draw up out of the larger leaf a paddle of sufficient size to make the smaller leaf expose a greater surface to the pressure of the water, when, of course, the gates would open by the down-stream pressure, as they would in the other case by the up-stream pressure. The paddles may be worked by self-acting balance weights, or by a water wheel set in motion by the fall of the tide, so as to make the whole self-acting. The water, after its discharge, may be directed by proper jetties into the channel required.

Over the intermediate space of sand and silt, betwixt rock and rock, I would propose an embankment composed of rock and earth in the manner shown in the drawing; the centre of the bank of puddled earth or clay; and the outer parts of rock faced with heavy squared pitching brought up from low water in a curved manner, as shown in the drawing. In order to secure as much as possible or necessary the water tightness of the bank, I would recommend a row of sheet piling perhaps 25 or 30 feet deep on each side of the puddle wall in the centre of the bank, and at the foot of each slope another row of shorter piles, to prevent the pressure of the bank forcing out or blowing up the sand foundation.

A carriage road to be formed over the whole, passing over the locks by draw or swivel bridges, and over the sluices by stone or wooden arches.

This plan, with 15 feet of water impounded, would afford a sectional area of discharge of 5,970 square feet. The calculations in my report are made upon an area of 2,400 square feet only, so that, if by that amount the scouring power was trebled, it would, by using all the means which the locks and sluices of the plan just detailed afford, be increased more than seven-fold.

At a ten feet tide at Runcorn, the sectional area of the stream is now about 9,860 square feet. The locks and sluices would afford at the same height about 4,120 square feet. Although this is less than half the present sectional area, a difference of level of considerably under a foot would so increase the velocity through the sluices as to pass the same quantity of water.

WARMING BUILDINGS BY HOT WATER.

The subject of warming buildings by hot water having lately excited a more than ordinary degree of interest, owing to the recent disastrous fire at Manchester, we lay before our readers a report made to the Manchester Fire Assurance Company, by Mr. John Davies, M. W. S., and Mr. G. V. Ryder. (We shall continue the subject in our next.)

"Before we proceed to detail the experiments which we have made, we shall briefly describe the appearances observed, and the information obtained at a few of the principal places which have been visited. We shall then be enabled not only to confirm but to extend the statements in Mr. Ryder's first report.

It has been found, on inspection, that Birch Chapel has, at various times since the occurrence alluded to in the former report, sustained much damage. Wood, matting and cushions have, in a variety of places contiguous to the hot water pipes, been charred to an alarming extent.

With respect to Mr. Barbour's warehouse, farther inquiry has fully corroborated the previous statements of its having been on fire, close to the pipes, at different times and in different places.

Of the Unitarian Chapel, in Strangeways, the directors are already in possession or information from both Mr. Ryder and Mr. Rawsthorne, and this information seems to leave no doubt as to the injury which has resulted from the use of Mr. Perkins' hot water apparatus.

The heat in the Natural History Museum having been repeatedly stated to vary in different parts of the pipes, and to become, in some cases, the greatest at places remote from the furnace, the fact has been confirmed by our own observations, and by our subsequent experiments. As this circumstance has excited much interest, and been generally questioned, we shall presently endeavour to assign the cause.

The apparatus, which it may be proper to notice in reference to its general form and construction, consists simply of a long, endless iron tube, carried, in different directions, from a furnace to which it returns, and in which about one-sixth of the whole length is inserted and formed into a coil, so as to be sufficiently exposed to the action of the fire. The tube is, at the commencement, filled, or nearly filled, with water, which, by the application of the heat, soon begins to circulate, and, in that way, to impart an increase of temperature to the apartments which it traverses. The dimensions of the pipes are such, that, on the average, eleven feet in length will contain one pint of water. Connected with the principal pipe are two others, which are opened by a screw, one to allow for the ultimate expansion, and both subservient to the introduction of water.

As far as lay in our power, we have made such experiments aa occurred to us, repeatedly, and under every variety of circumstance.

Not having any instruments which would furnish speedy and adequate criteria for the determination of high temperatures, we have resorted to the inflammation of combustible bodies, and the fusion of others, depending on the recent and high authority of Professor Graham for the degrees which they indicated.

The ordinary method hitherto resorted to for ascertaining high temperatures in the pipes, is to file a small portion perfectly smooth, and observe the progressive change of colour which occur. We did not neglect this experiment, and we witnessed, to great advantage, the successive and beautiful tints. As the temperature increased, we were presented first with a straw colour, then a deep bluish purple, and, finally, with a dark silvery hue. The first is said to indicate 450, and the blue 600.

In the Natural History Museum we applied our tests, but were enabled to do so only to a very limited and unsatisfactory extent. Mr. Walker, the proprietor of the patent right for Manchester and the neighbourhood, accompanied us to the establishment of Messrs. Vernon & Company, engravers, where we had the opportunity of trying the system rather better, but still imperfectly. Finally, Mr. Walker acceded to our request to have put up, on his own premises, a suitable apparatus, which was to be submitted entirely to our control. It consisted of an iron pipe upwards of 140 feet in length, 26 of which were coiled in the furnace; 20, at least, being freely exposed to the full action of the fire.

In addition to the apparatus, as at first fitted up, we had a branch pipe and a stop cock, which enabled us, by cutting off at pleasure a great portion of the circulation, to perform our experiments on a contracted scale, and under a variety of modifications.

Mr. Walker, being from home at the time, placed his foreman entirely under our directions, so that we had the opportunity of pursuing the investigation to any extent which we might think proper. It is but justice to state, that this person rendered, very willingly and with much practical skill, all the assistance which was required.

The apparatus having, on Friday the 5th ult., been fitted up and found on trial, to be in proper condition, the experiments were commenced on the following morning, at ten o'clock, when the apparatus had arrived at a suitable state.

I. *First class of experiments, viz. those made with the whole length.*

1. The pipe from the furnace became very soon sufficiently hot to singe and destroy small feathers resting upon it.
2. Speedily afterwards, the same pipe exploded gunpowder.
3. On the highest pipe, within a foot of the expansion pipe, bismuth was readily melted, denoting a temperature exceeding 470°. The pressure at this point must have exceeded 35 atmospheres, or above 525lb. on the square inch.
4. Feathers were singed instantly, and matches lighted, at the same place.
5. Gunpowder inflamed readily in various parts of the flow pipe, and on the expansion pipe.
6. Blocks of wood, of five different species, were charred: from the dea wood the turpentine issued profusely.
7. Other combustible materials were also severally much charred.

II. *Class of experiments, with the shorter circulation. By this change a greater pressure was immediately observable, as the expansion pipe and several of the joints emitted steam, and admitted the escape of water.*

1. Cane shavings, on the pipe above the furnace, readily inflamed.
2. Lead melted at the same place; and the temperature must, therefore, have exceeded 612°. Making a rough calculation from the table of the French Academy, which does not extend beyond 50 atmospheres, I take 612° to represent 75 atmospheres, or about 1,125lb pressure on the square inch.
3. Different wood shavings inflamed on the upper pipe.
4. Cotton ignited freely at the same place.
5. Matting inflamed at the same place.
6. Cotton, hemp, and flocculent matter, collected from Mr. Schwabe's fustian room, ignited on the returning vertical pipe.
7. The blocks of wood, tied to different parts of the tube, were much acted upon and charred in a very short time.

Observing the expansion pipe to be in a state of considerable agitation, and warned of an explosion, the temperature was reduced, and the experiments were, for the time, suspended.

The pipes having, before three o'clock, been refilled and screwed up, for the express purpose of an explosion, the following experiments were made in the progress of the preparation:—

1. Mungeet was readily ignited.
2. Different sorts of paper and pack thread were destroyed.
3. Bismuth fused instantly.
4. Cotton inflamed.
5. Sheep's wool became speedily charred, in 2″ or 3″ after the stop-cock closed.
6. At five o'clock the sheet lead, affixed to the upright pipe, freely melted; steam issued violently from the bend in one of the upper horizontal pipes, and, in three minutes afterwards, the explosion occurred in the furnace pipe, at the top of the seventh coil, which presented, on subsequent examination, a lateral aperture about two inches long and about one-sixteenth of an inch broad.

In the lapse of two or three minutes after the commencement of the explosion, the furnace was entirely emptied of its contents, which were propelled, in a divergent direction, like one mass of fire, so as almost to fill the apartment. The force with which the ignited embers rebounded from the opposite wall, and other obstructions, occasioned them to scatter in profusion like a shower of fire over every part of the place. The noise was so great as to bring to the spot a multitude of people from the adjoining streets. A number of articles in the shop—as, for example, packing cloth, paper, and hemp—were subsequently found to be on fire in different parts of the premises.

These appearances, and their immediate effects, seem to have been precisely similar to those which are said to have been witnessed at the explosion in the warehouse of Messrs. Crafts and Stell, and would evidently have been adequate, in the same situation, to produce all the consequences.

It may be here observed, that the experiments clearly prove, that the heat, in different parts of the pipe, is not uniform. Generally it is greatest at the highest elevation, where its superior temperature appears to be of the longest duration under ordinary incidental changes. At the commencement of the operation, however, and a short time after fresh fuel had been applied, the temperature was highest in the flow-pipe contiguous to the furnace. Another circumstance, likely to produce an inequality of heat, may be adverted to: the tubes are far from being of uniform internal diameter: the consequence of which must be, that as the same quantity of water has to pass, in the same time, through every part of the apparatus, the liquid must move with greater velocity at one place than at another, and thus, from obvious causes, develop a greater quantity of caloric. The difference is sometimes so great in the relative bores of the tubes employed, that in some which were examined, one tube had an internal diameter of 9-16ths, and another of ¾ths of an inch, that is to say, in the ratio of three to four; or, taking the relative areas or sections of the tubes, which represent the relative quantities of fluid contained in a given length, in the proportion of nine to sixteen. Thus, taking the velocity reciprocally as the section of the pipe, the velocity of the water at one part of the apparatus being represented by sixteen feet, the velocity in another part would be nine, or the rapidity of the current would be at one place nearly double that which it was at another.

It is stated, in a work recommending the hot water system, that "the application of heat fills" the ascending or flow-pipe "with minute bubbles of steam which rise rapidly to the upper part of the tube, and become there condensed into water again:" now, as condensed steam, wherever it occurs, produces about seven times as much heat as the same quantity of water at the same temperature, we have, at once, a reason for the heat of the pipe being generally greater at a distance from the furnace than contiguous to it. This apparent anomaly, which has been repeatedly observed and denied, admits, therefore, of an easy explanation.

The explosion may, under different circumstances, occur from various causes.

1. As water expands in bulk about five per cent. from 40°, its point of greatest density, to 212°, the boiling point, the expansion must be very considerably more when raised to high temperatures. If, therefore, the pipes be nearly filled with water, and the expansion pipe not adequate or in proper condition, an explosion must be inevitable. Dr. Graham states, that, from freezing to boiling water, the expansion is from 22.76 to 23·76 = 100 to 104·4 nearly.

2. The conversion of the water into vapour, producing an expansion which is in the proportion of a pint of water changed into 216 gallons of steam, "with a mechanical force sufficient to raise a weight of 37 tons a foot high," must present a pressure upon the tubes sufficient to ensure their destruction. Dr. Graham makes a cubic inch of water to expand into 1,694 cubic inches of steam, or one pint of water to become nearly 212 gallons.

3. It has been observed, as an ordinary occurrence, by those much accustomed to the apparatus, that, in some cases, a quantity of gas is generated, and has been found to escape, in considerable quantity, when an aperture is made in the upper part of the pipes. The only gases which could be thus obtained are the elements of the water, oxygen and hydrogen. The former would probably be taken up in the oxydation of the metal. Now the hydrogen gas, which would remain, has never been deprived of its elasticity, and never made to change its state, by any compressing force hitherto applied. It is obvious, therefore, that inevitable danger must arise from its production. It may be worth while to remark, that air, steam, and hydrogen gas expand in the same proportion by augmentations of temperature. The law discovered at the same time, and by independent methods of experiment, arose out of the researches of Dr. Dalton and M. Gay Lussac. It may be thus expressed: Aeriform bodies expand the 1-480th part of their bulk on the addition of each degree of temperature. Thus, taking 480 cubic inches of steam or hydrogen gas at 32°, the mass becomes, at 33°, 481 cubic inches; at 34°, 482, cubic inches; and so on: or, in a general form, a bulk a raised $d°$ of temperature becomes $a + \frac{d}{480}$.

4. The last source of explosion to which it is necessary to refer, arises from any casual impediment in the pipes; and it freely admitted, that in frosty weather such an impediment is likely to occur; it has been found to result from other causes, as in the case of extraneous matter accidentally getting into the pipes, an example of which was recently presented in the establishment of Messrs. Wood and Westheads.

In a very obliging letter received, in the course of the investigation, from Sir Robert Smirke, it is stated, that, though he has "never seen the pipes heated sufficiently to ignite wood, except on one occasion," yet, "if a fire is incautiously made when there if a stoppage in the pipes from frost or other accidental cause, the pipe within the furnace may be burst or made red hot near the furnace. I have known the pipe," he adds, "so heated only in one instance, when the red heat extended to a distance of upwards of 12 feet from the furnace."

Sir Robert concludes his letter by suggesting a protective modification of the apparatus. "Therefore," he observes, "to prevent the risk of fire to a building, I would never place the furnace in a room or cellar that is not fire proof, nor would I have the pipes in any part of their circuit in *actual contact* with wood or other combustible material. Security," he continues, "is still more effectually attained by having a safety-valve upon the pipe near the furnace, by which explosion or excess of heat would be prevented."

That which has happened once, may, under the same circumstances, happen again. The exclusion from *actual contact* with combustible materials, could it be permanently ensured, would, when the red heat extended along the pipe upwards of twelve feet, afford, at least, very reasonable grounds for apprehension.

On this system of warming buildings, therefore, danger must be produced from either negligence in the feeding of the furnace, or any stoppage in the pipes: the former evil may be obviated by proper precautions; but the latter, occurring unexpectedly, exists unobserved, and precaution and care must be equally unavailing."

Signed. JOHN DAVIES,
GEORGE VARDON RYDER.

March 10, 1841.

ON THE STYLE OF WREN.

FOLLOWING in the train of Palladian architects comes Wren, another of the school, though exercising its sentiments in a different way. He took from Palladio the idea of modifications, as also he learned from Jones the art of distribution: but then, he also learned a something of the sentiment of English architecture, and so fashioned a style compounded of them all. Not that he deviated from classic rule, or indulged in a detail inconsistent with the whole. This Wren could not do. But inasmuch as the broad masses of Palladio and Jones, were to be sacrificed to the more modest limits of ecclesiastical structures, he had to prepare his features for altitude rather than for breadth. Instead of the artist having to lead the eye upward, he had now to prevent its too hasty ascent, and had to enchain the fancy here or there, as if to compel the eye to wander where otherwise it would instantly soar. In him we see the first architect of his school for beauty of outline and simple elegance of form. In Jones we view the artist more in his dispositions of effect, more in the skilful appropriation of the parts, than in the finished elegance of the parts themselves. In Wren we see more justness of expression, more attention to parts, and richness more tempered with chastity. Jones was the master, natural and often carelessly so, Wren was the master, designing more by principles, and adjusting leading objects ere the richness of ornament appeared. Jones seemed to delight in masses of light and shade, in bold contrasts, in feeling touches. Wren allowed the form of a part to display its dignity, and allowed the contrast to appear in changing outlines. Both took their lesson from Palladio, but Wren studied symmetry the most. Jones took Palladio's errors and revived them; Wren improved upon both in the outline. He took also from the antique to improve, as he also borrowed from Michæl Angelo to surpass him.

Besides this, Wren was the first to bend Roman architecture into the poetry of the Christian without violence to either. This idea springing up on the decline of Roman art, and differently exhibited at later periods and in the middle ages, was perfected by him until classic orders and figures tapered into every variety of elegance. But the spirit of design in Wren was different from that in the olden times. A departure from Roman precedent was then an innovation, in which the purity of Roman detail was *sacrificed* to new forms and increasing altitude, whereas Wren on the contrary, on the restoration of the Basilica, caught the poetry of the monks only to give life and richness to Roman grandeur. Wren's great aim was to give the eye a succession of pyramidal objects, the moment those objects were separated from the mass; there is otherwise a repose and solemn dignity about the lower parts of his edifice. To carry out this idea involved a variety of figures and a change of ornament, which became as essential to the line of ascent as necessary to enrich. The line of ascent is never broken: the eye easily advances, whilst, as it advances, a change as consistent as various appears to meet it. In St. Paul's there is a total contrast between the lower part and the superstructure. In St. Peter's there is a breadth of parts about the superstructure unrelieved. In St. Paul's the horizontal lines growing gradually less prominent towards the dome terminate into sweeping perpendiculars. In St. Peter's the horizontal is never sacrificed for a moment. In St. Paul's the objects multiply in proportion to the height, as also parts get smaller, that is, divisions and subdivisions of parts appear, whilst each grows narrower and more towards a pyramid. Where Wren grew in endless variety, the architects of St. Peter's only tamely ascended.

Wren therefore was the first who whilst he spread grandeur and massive repose beneath, drew the eye by a thousand artificies into the more pleasing beauties above.

If Palladio gave the same spirited outline to the basilica, Wre improved upon him by the variety rather than by the number by his contrivancies.

Thus far we see the peculiar excellencies of Wren, which whilst they mark him as a Palladian architect, evince an original turn for purity of style. It is to be regretted that the works of the French architects influenced him so much in Winchester palace, and affected his designs for palaces and private buildings, for then there would be no blemish upon his architectural fame. As an ecclesiastical architect he ranks as the first, casting by the brilliancy of his genius Palladio and his other followers into the shade. In conclusion, he differed from Jones materially in the position of lines, conceiving only two beautiful positions of straight lines to exist, namely, perpendicular and horizontal, whereas Jones delighted in oblique positions. He saw the great meaning and beauty in these as they existed in the mansions of Palladio, and traced them, as he did all things, to their derivation—nature.

FREDERICK EAST.

March, 1841.

PROGRESS OF RAILWAYS.

London and Brighton Railway.—The works on this great undertaking are approaching completion at even a more rapid pace than the last report of the Directors gave us reason to expect. Both the Merstham and Balcombe tunnels are finished; and a small portion only of cutting remains to be excavated at the approaches. Mr. Rastrick, the engineer, has engaged to convey a party of the Directors on the line from London-bridge to Hayward's-heath in the course of a month. At Clayton the tunnel is nearly finished; and the line will be completed from Brighton to the Hassocks station in June, leaving only the small portion of the line which extends from the Hassocks to Hayward's-heath unfinished. We are assured that the opening of the line throughout the entire distance will take place by August next.—*Brighton Gazette.*

Manchester and Leeds Railway.—The Summit Tunnel, the only portion of this railway which remained unopened, being completed, this line was opened throughout on Monday. The train consisted of two carriages; both being of an entirely new construction, but somewhat different from each other. The body of one of them is about 18 feet by 7, and is 6 feet 6 inches high. There is a compartment in the centre 7 feet square, and is built after the fashion of a gondola. The interior of this compartment is fitted up with splendid mahogany sofas, lined with crimson plush, and trimmed with silk gymp; and the top part above the sofa boxes is composed of plate glass with silk curtains. The two end compartments are open above; but a curtain made of waterproof fabric can be drawn down at pleasure to screen the passengers from the rain, so that in these carriages a person may enjoy all the comforts of a first-class carriage; and at the same time, be enabled to survey the country through which he is passing. The other carriage, the *Tourist*, is similar in its general arrangements, but is fitted up differently. These carriages, which were made by Mr. Melling, of Greenheys, are adapted for summer travelling; there are but two of them, and they are merely for an experiment. The fares in them will, we understand, be the same as in the first-class carriages. The first goods train, which passed through, was drawn by an engine called the *Manchester*, made by Messrs. Sharp, Roberts and Co., of Manchester.—*Leeds Intelligencer.*

Manchester and Birmingham Railway.—In the last number of the Journal we announced that the directors of this great undertaking have selected the design of Messrs. Carpenter and Blythe, of London, for their station, and we think this selection is one which will have the effect of adding another fine specimen of architecture to Manchester. The designs have been submitted to public exhibition at the Victoria Gallery. The approach to the station commences in Ducie-street, London-road, from which an inclined carriage way leads on to the railway, which is thirty-two feet above the level of Store-street. The internal arrangements of the station, of which we have been favoured with a sketch, are exceedingly convenient, and appear to combine all the improvements in railway engineering, with the addition of some novelties, for which the directors are indebted to their distinguished engineer, G. W. Buck, Esq. Of these the most striking are, the situation of the engine stable and the construction of the turn table, or apparatus for moving the engines and carriages from one line of rails to another. The engine stable, which will contain stalls for six engines and tenders, is placed at the terminus of the rails, instead of being at a distance from the station, the position usually adopted, by which plan much time will be economised in the dispatch of the trains. By this arrangement the engines, after bringing the trains into the station, can be detached therefrom and turned round without the engine and tender being uncoupled, and then go into the stable to remain there, or to receive coke and water, and return upon another line of rails to the departure side of the station, to take out another train, or proceed to the principal engine depôt at Longsight. This turn table consists of a circular plate of iron, thirty feet in diameter, to be moved by a small steam engine proposed to be erected. The mode of turning the table is very ingenious. Instead of the ordinary method of employing manual labour, Mr. Buck intends to make a portion of the under side of the plate answer the purpose of a pulley, a strap or chain being passed round it, and a fixed pulley in connexion with the steam engine, and by these means the ponderous machine and its load will be moved round with the greatest ease, and the labour of at least half a dozen men will thus be saved.

STEAM NAVIGATION.

The United Steam Frigate Missouri.—From the New Orleans Picayune.—This magnificent vessel is constructed principally of live oak from Attakapas, in this state, and her entire cost is 500,000 dollars. In her rig she will resemble a handsome bark, and her builder has constructed the hull so admirably, as to render her, as a sailing vessel, a No. 1 of the United States navy. She will sail the greater part of the time, as her bunkers only carry about 800 tons of coal, or sufficient for 20 days' steaming. Her spars, particularly the foremost and mainmast, are as heavy as those of a first class frigate, and she is so constructed as to be able to ship and unship her paddle-wheels with the greatest facility. She is pierced for 26 guns, but will carry but 18—6 aft the wheel-house, and 3 forward of it on each side. She is to carry two 10-inch guns forward, which are to traverse the greater part of a circle on a swivel; these two guns will be able to carry shot nearly 100 pounds weight, as 8-inch guns carry 64 lb. shot. The other 16 guns are to be 8-inch bore. On account of the result of various trials, the whole of ordnance is to consist of Paixhan guns. She will be ready for sea in July next.

Taylor's Improvements in Steam Boats.—We have been informed that Capt. Taylor, of her Majesty's ship San Josef, has lately been engaged in a course of experiments in Hamoaze, with a view to the prevention of collisions between steam-vessels, and steam and sailing vessels, such as those which have of late been of so frequent occurrence, and which have been attended with such deplorable loss of property and life. Our informant states that those experiments promise the most satisfactory result. He says that Captain Taylor "has discovered a plan by which the steam boat will be placed completely under the control of the persons on deck, as, immediately danger is seen, the steamer can be stopped, or turned round upon her own centre, and within her own length, without stopping the engine, or calling to the engineer." We have been furnished with some details relative to Captain Taylor's invention, which we withhold for the present, as we understand he contemplates taking out a patent; but should his discovery, when farther tested, be found practicable, and should it have the effect of preventing, in future, such melancholy consequences as those which resulted from the late collision between the Nottingham and Governor Fenner, this able and meritorious officer will have rendered a most important service to the interests of humanity.—*Times.*

British Queen and President Steam Ships.—It was whispered in the more select commercial circles on Monday, that the British and American Steam Navigation Company had sold their magnificent ships, the British Queen and President, to the Belgian Government. The President is now on her voyage from America, and will, it is added, have to be surveyed before the contract can be considered definitively concluded; but, if our information be correct, of which we have no doubt, the British Queen has already been "proved," and is, in fact, the property of the Belgian Government. The future destination of the two vessels is scarcely less certain. The Belgians are anxious to push their commerce in every possible way, and we believe it will turn out that the British Queen and President have been purchased with the view of forming a regular steam communication between Antwerp and New York. —*Morning Post*

The General Steam Navigation Company.—The half-yearly meeting of the proprietors was held on Tuesday, the 23rd ult., at the office in Lombard-street. From the report of the directors it was collected that the operations of the past year had been attended with success, and that the affairs generally were in a course of prosperous advancement. Full explanations were entered into upon various points interesting to the proprietors, and appeared to afford much satisfaction. It was resolved, that a considerable sum should be appropriated toward the cost of two large steam ships of 650 and 900 tons, now building by Messrs. Green, Wigram, and Green, and the customary dividend and bonus were declared.

MISCELLANEA.

Artesian Well at Vienna.—For some time past these works had been going on in the vicinity of the barracks in the Corn Market, when, after digging 96 Austrian fathoms, the undertaking was crowned with complete success, in the first week of the present month. The water rushes up in such abundance, that it has been estimated to exceed 12,418 gallons per day, and when it first made its appearance, it was with some difficulty that several shops in the neighbourhood were preserved from inundation.

Artesian Wells in the Oasis of Thebes.—This Oasis is twenty-three leagues in length, and from two to four in breadth, and is studded with Artesian wells, which have been noticed by Arago. The ancient inhabitants used to dig square wells through the superficial vegetable soil, clay, marl, and marly clay, down to the limestone, from twenty to twenty-five metres in depth. The last rock contains the water which supplies the wells, and is called by the Arabs *Agar el moya*. In the rock, holes were bored from four to eight inches in diameter. These holes were fitted with a block of sandstone supplied with an iron ring, in order to stop the supply, when there was danger of inundating the country.

Crowland Abbey.—A new gallery is in course of erection in this sacred edifice capable of accommodating 150 sitters, which, with other improvements made, and in contemplation, will add greatly to the beauty of this truly "majestic pile of Gothic grandeur."

New Pier at Chelsea.—Lord Cadogan has given instructions for a splendid pier to be erected in Cheyne-walk, Chelsea, opposite the place where the Bishop of Winchester's palace formerly stood, and Mr. Lewis Cubitt has taken the [illegible] street from the water [illegible] to be [illegible] the iron [illegible] Friday [illegible]

Asphalte.—[illegible] the Directors of the [illegible] Asphalte Company [illegible] Patent [illegible] contract with the Greenwich Railway Company [illegible] the [illegible] their Junction line, to the extent of 240,000 superficial feet. It is [illegible] that the floors of the several cells of the model prison [illegible] with this material.

New Lighthouse at Plymouth.—The ceremony of laying the foundation stone of the lighthouse intended to be built on the west end of the Plymouth breakwater, took place [illegible] the weather was delightfully serene, which added much to the [illegible] of the occasion. The stone having been prepared it was [illegible] and [illegible] Rear Admiral Warren, Admiral Superintendent of the [illegible] having plumbed it, spread the mortar, and [illegible] coins of the realm were deposited beneath the stone.

Engineering Honours.—We have much [illegible] to announce that Isambard Brunel, the engineer-in-chief of the Thames Tunnel, has been knighted by Her Majesty; we hope that this is the commencement of [illegible] [illegible] to the [illegible] profession. [illegible]

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 23RD FEBRUARY, TO 25TH MARCH, 1841.

Six Months allowed for Enrolment.

GEORGE ENGLAND, of Westbury, Wiltshire, clothier, for "*improvements in machinery for weaving woollen and other fabrics, and for twisting, spooling, and warping woollens, also for improvements in the manufacture of woollen doeskins.*"—March 2.

JOHN WILKIE, Nassau-street, Mary-le-bone, upholsterer, and JOHN CHARLES SCHWIESO, of George-street, Saint Pancras, musical instrument maker, for "*improvements in constructing elastic seats or surfaces of furniture.*"—March 2.

HENRY NEWSON BREWER, of Jamaica Row, Bermondsey, mast and block maker, for "*an improvement or improvements in wooden blocks for ships, rigging, tackles and other purposes, where pullies are used.*"—March 3.

JOHN RAND, of Howland-street, gentleman, for "*certain improvements in machinery for the manufacture of frame work knitting or hosiery.*"—March 6.

THOMAS SPENCER, of Liverpool, carver and gilder, for "*an improvement, or improvements in the manufacture of picture and other frames, and cornices applicable also to other useful and decorative purposes.*"—March 8.

JOHN VARLEY, of Bayswater Terrace, Bayswater, artist, for "*an improvement in carriages.*"—March 8.

JOHN WILLIAM NEALE, of William-street, Kennington, engineer, and JACQUE EDOUARD DUYCK, of Swan-street, Old Kent-road, commission agent, for "*certain improvements in the manufacture of vinegar, and in the apparatus employed therein.*"—March 8.

BENJAMIN SMITH, of Stoke Prior, near Bromsgrove, butcher, for "*an improved apparatus for making salt from brine.*"—March 8.

JOHN WALKER, of Crooked-lane, King William-street, for "*an improved hydraulic apparatus.*"—March 8.

RICHARD LAWRENCE STURTEVANT, of Church-street, Bethnal Green, soap manufacturer, for "*certain improvements in the manufacture of soap.*"—March 8.

THOMAS JOSEPH DITCHBURN, of Orchard House, Blackwall, shipbuilder, for "*certain improvements in ship building, some, or all of which, are applicable to steam boats, and boats, and vessels of all descriptions.*"—March 8.

ANTHONY TODD THOMSON, of Hind-street, Manchester-square, doctor of medicine, for "*an improved method of manufacturing calomel and corrosive sublimate.*"—March 8.

STEPHEN GOLDNER, of West-street, Finsbury Circus, merchant, for "*improvements in preserving animal and vegetable substances and liquids.*"—March 8.

JOHN WERTHEIMER, of West-street, Finsbury Circus, printer, for "*improvements in preserving animal and vegetable substances and liquids.*" (A communication.)—March 8.

THOMAS CLARK, professor of chemistry, in Marischal College, Aberdeen, for "*a new mode of rendering certain waters (the water of the Thames being among the number,) less impure and less hard for the supply and use of manufactories, villages, towns, and cities.*"—March 8.

JOHN BAPTIST FRIED WILHELM HEIMANN, of Ludgate Hill, merchant, for "*improvements in the manufacture of ropes and cables.*" (A communication.)—March 8.

JOHN DOCKREL, of Galway-street, Saint Luke's, gas fitter, for "*an improvement, or improvements on gas burners.*"—March 15; two months.

RICHARD LAMING, of Gower-street, Bedford-square, surgeon, for "*improvements in the production of carbonate of ammonia.*"—March 15.

WILLIAM NEWTON, of Chancery-lane, civil engineer, for "*certain improvements in machinery or apparatus for picking and cleaning cotton and wool.*" (A communication.)—March 15.

ROBERT WARINGTON, of South Lambeth, Surrey, gentleman, for "*improvements in the operations of tanning.*"—March 16.

JOSEPH MAUDSLAY, of Lambeth, Surrey, engineer, for "*an improvement in the arrangement and combination of certain parts of steam engines, to be used for steam navigation.*"—March 16.

WILLIAM NEWTON, of Chancery-lane, civil engineer, for "*improvements in spinning and twisting cotton, and other materials capable of being spun and twisted.*" (A communication.)—March 16.

GEORGE LOWE, of Finsbury Circus, engineer to the chartered gas company, for "*improved methods of supplying gas under certain circumstances, and of improving its purity and illuminating power.*"—March 16.

CHARLES BENT DYER, of Pary's Mine, Anglesea, mine agent, for "*an improved method of obtaining paints or pigments by the combination of mineral solutions and other substances.*"—March 16.

LAURENCE KORTRIGHT, of Oak Hall, East Ham, Essex, Esq. for "*certain improvements in treating and preparing the substance commonly called 'White Bone,' and the fins and such like other parts of whales, and rendering the same fit for various commercial and useful purposes.*" (A communication.)—March 17.

WILLIAM THOMPSON CLOUGH, of Saint Helens, Lancaster, alkali manufacturer, for "*improvements in the manufacture of the carbonates of soda and potash.*" (A communication.)—March 17.

HENRY AUGUSTUS WELLS, of Regent-street, gentleman, for "*improvements in [illegible] dressing [illegible].*" (A communication.)—March 17.

JOSHUA FIELD, of Lambeth, engineer, for "*an improved mode of [illegible] the operation of connecting, and disconnecting [illegible] steam engines, [illegible] paddle wheels, used for steam navigation.*"—March 22.

RICHARD BARNES, of Wigan, Lancaster, engineer, for "*certain improvements in machinery, or apparatus for raising or drawing water and other fluids.*"—March 22.

ANTHONY THEOPHILUS MERRY, of Birmingham, refiner of metals, for "*an improved process, or processes for obtaining zinc and lead from their respective ores, and for the calcination of other metallic bodies.*"—March 22.

ROBERT WALTER WINFIELD, of Birmingham, merchant and manufacturer, for "*certain improvements in, or belonging to metallic bedsteads, a portion of which may be applied to other articles of metallic furniture.*"—March 22.

ROBERT GOODACRE, of Ullesthorpe, Leicestershire, for "*an improved mode of weighing bodies raised by cranes or other elevating machines.*"—March 22.

DAVID NAPIER, of Mill Wall, engineer, for "*improvements in propelling vessels.*"—March 22.

ACHILLE ELIE JOSEPH SOVITAS, of George Yard, Lombard-street, merchant, for "*improvements in apparatus for regulating the flow of fluids.*" (A communication.)—March 22.

WILLIAM BUCKNELL, of Westminster, gentleman, for "*improvements in applying heat for the purpose of hatching eggs, which improvements are also applicable to other useful purposes where heat is required.*"—March 22.

MORRIS WEST RUTHVEN, of Rotherham, engineer, for "*a new mode of increasing the power of certain media, when acted upon by rotary fans or other similar apparatus.*"—March 22.

ROBERT COOK and ANDREW CUNNINGHAM, of Johnstone, near Glasgow, engineer, for "*improvements in the manufacture of bricks.*"—March 22.

MOSES POOLE, of Lincoln's Inn, gentleman, for "*improvements in stretching cloths.*" (A communication.)—March 22.

JOSEPH WRIGHT, of Carisbrook, Isle of Wight, mechanic, for "*improvements in apparatus used for dragging or skidding wheels of wheeled carriages.*"—March 22.

THOMAS WRIGHT, of Church Lane, Chelsea, Lieutenant in Her Majesty's Navy, for "*certain improvements applicable to railway and other carriages.*"—March 22.

EDWARD FINCH, of Liverpool, ironmaster, for "*improvements in propelling vessels.*"—March 25.

GOLDSWORTHY GURNEY, of Bude, Cornwall, Esq., for "*improvements in the production and diffusion of light.*"—March 25.

ERRATA IN LAST MONTH'S JOURNAL.

Page 75, col. 1, two lines from bottom, for "[illegible]style" read "[illegible]style."
Page 77, col. 2, line 21, for "as one of" read "is one of."

TO CORRESPONDENTS.

We shall feel obliged if O. of Dublin, will favour [illegible] with any information respecting the progress of architecture or engineering works in Ireland.

We must decline inserting any further communication respecting Mr. [illegible]'s History of the London & Birmingham Railway, as it will involve us in [illegible] proceedings.

Upon consideration we must decline inserting H.'s communication [illegible] the reviewer's observations on Parsey's new work on Perspective; it is [illegible] for the reviewers to please all parties.

We shall be glad to receive from A Subscriber at Oxford, the [illegible] of the Oxford Architectural Society, and of the Camden Society.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," No. 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications [illegible] before the 20th (if with drawings, earlier), and advertisements on or before the 25th [illegible].

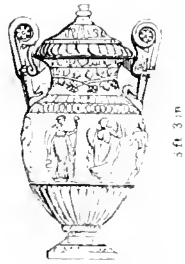
Vols. I. II. and III. may be had, bound in cloth, price £1 each Volume.

No. 47.—Grotesque Mask Vase.

No. 62.—Gothic Vase

No. 108.—Enriched Etruscan Urn.

No. 59.—Oriental Lotus Vase

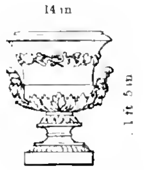


No. 119.—From the British Museum.

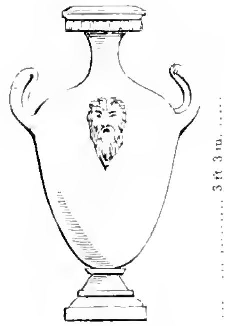
The same 2 ft. 8 in.

Also without Top, 17 in

No. 43.—Antique Festoon Vase.

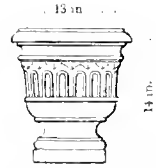


No. 46.—Convolvulus Wreath Vase



No. 103.—Greek Urn

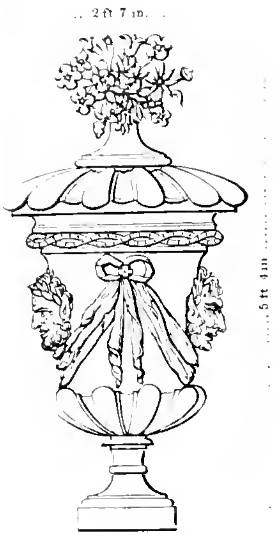
The same with Three Handles.



No. 53.—Maltese Vase.

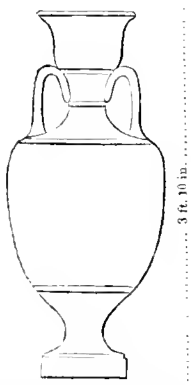
Also one 17 in. high, and 15 in. diam

No. 101.—Plain Greek Urn

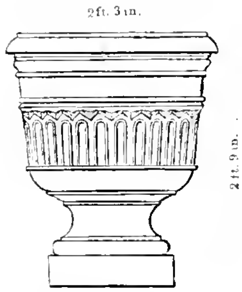


No. 32.—Bouquet and Mask Vase. (Italian.)

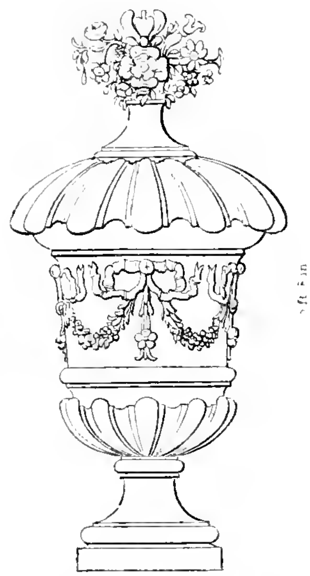

Vase for Ornamental Chimney Pot.

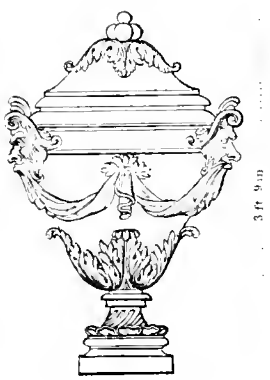


No. 106.—Plain Etruscan Urn.

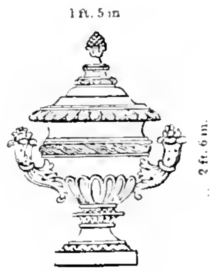


No. 51.—Maltese Vase

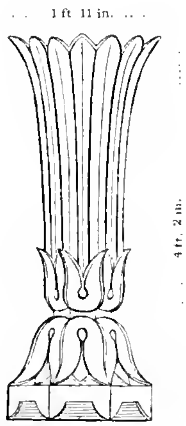

No. 33.—Bouquet and Festoon Vase (Italian.)



No. 110.—Draperied Urn



No. 102.—Guilochi Vase.



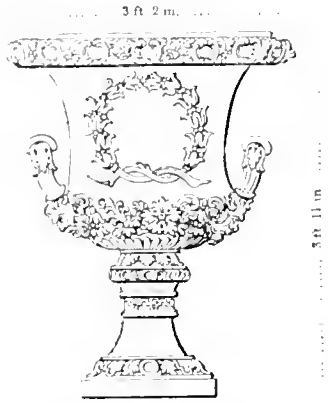
No. 56.—Oriental Lotus Vase.


No. 115.—The Bayswater Vase


No. 112.—Enriched Urn, with Cupids and Lions.

The Prices of the following Vases range from Ten Shillings to Thirty Guineas, Packing extra.

No. 9.—Borghese Vase



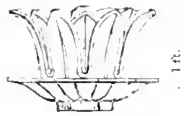
No. 40.—French Foliage Vase with Wreaths.

The same without Wreaths.

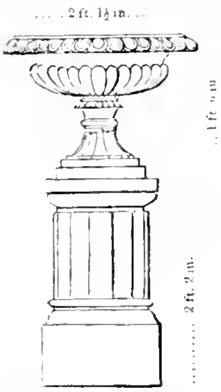
No. 11.—Grecian Vase.

No. 70.—The Bishop's Vase.

Also the same quite plain



No. 99.—Cup and Saucer.

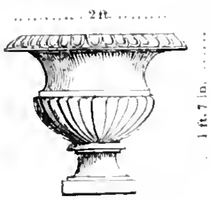


No 199.—Egham Tazza, and 672.—Small Fluted Column Pedestal.

(For Creeping Plants.)

No. 30.—A Reservoir Vase (Maltese.)

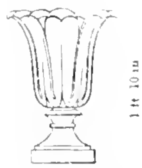
No. 14.—Grecian Vase on Plain Pedestal.



No. 65.—Isle of Wight Vase.

Also the same with Wreath of Ivy Leaves.

And another, plain, 15 in. diam.



No. 96.—Tulip Vase

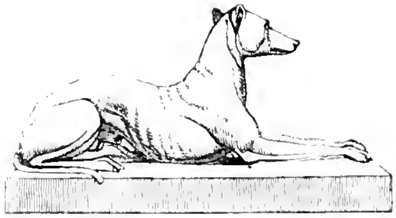
Also one 17 in. high

No. 29.—Figured Grecian Vase.

No. 38.—The Warwick Vase

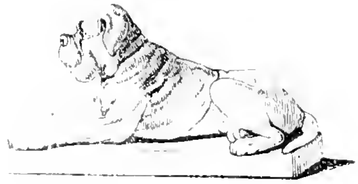
No. 35.—The Tamworth Vase

Also a Companion.



4 ft.

The Dog of Alcibiades
(Size of the original.)
Also the reverse, and one 16 in. high.



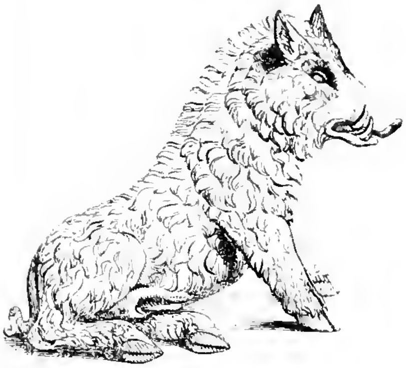
3 ft. 8 in.

The Old English Mastiff.
Also several other Dogs.

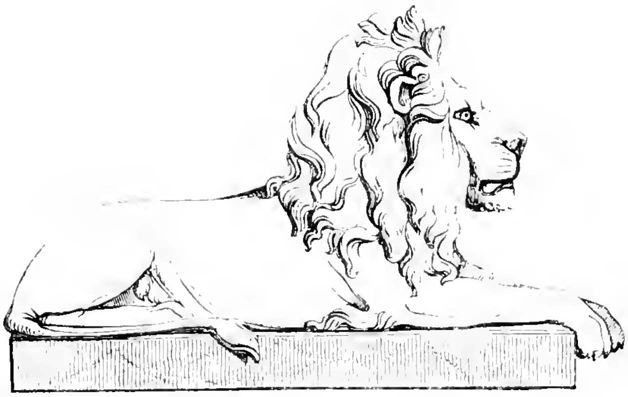
2 ft. 9 in.

2 ft.

Also an Elephant, and other small Models of Animals.



The Florence Boar. (Full life size.)
Also the reverse.

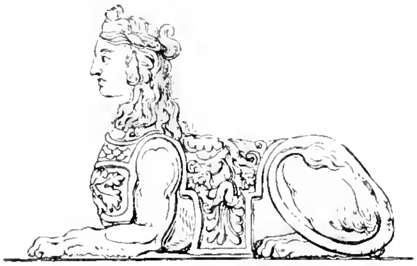


6 ft. 5 in.

Modelled from Nero.

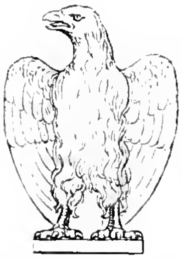
3 ft. 2 in.

3 ft. 3 in.



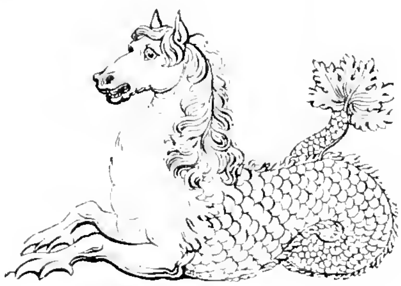
5 ft. 3 in.

Also another Model, 7 ft. 7 in.
Ditto, 5 ft.
A Pair of Lion and Lioness sleeping, 3 ft. each.



2 ft. 11 in.

Also a large Spread Eagle, 6 ft. 7 in. wide



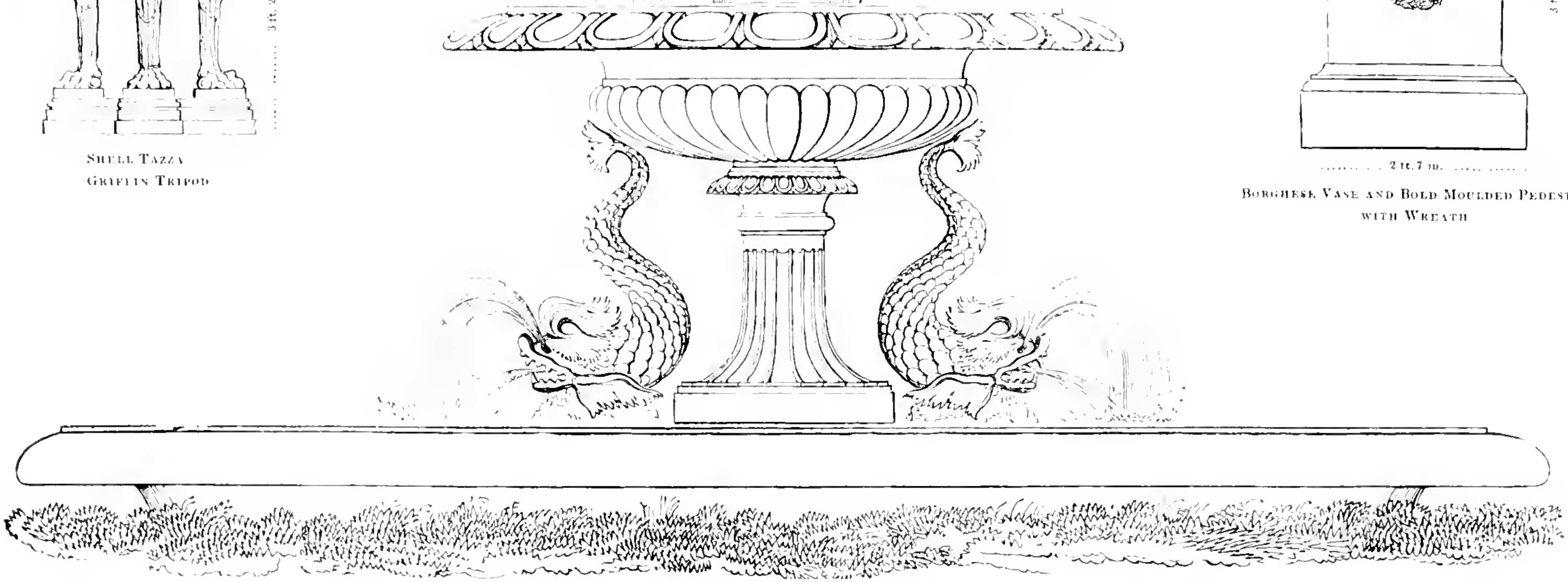
4 ft. 2 in.

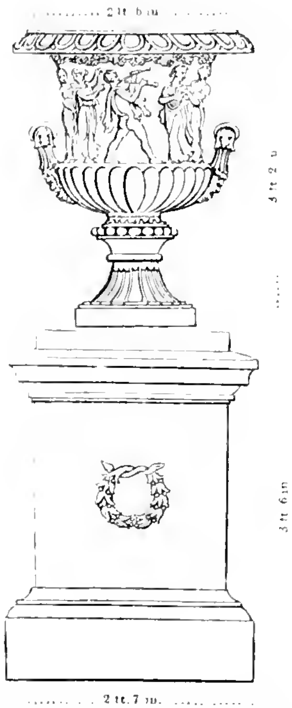
2 ft. 7 in.

Also another Model, with closed wings, 14 in. high.

A Set of Four Pigeons in different postures and other Birds, life size.

Shell Tazza
Griffin Tripod





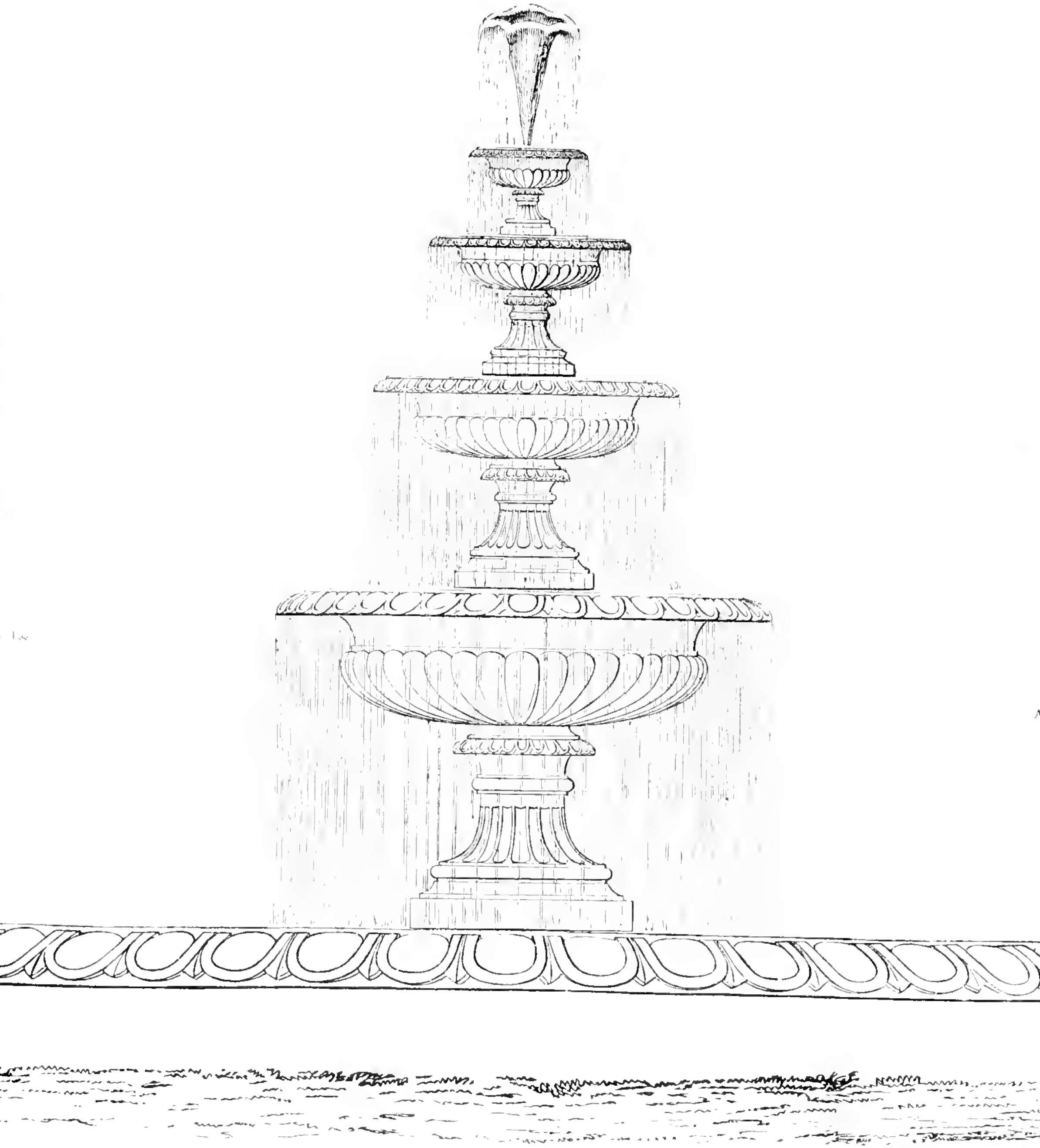
Borghese Vase and Bold Moulded Pedestal
with Wreath

THE SYPHON FOUNTAIN.

The Syphon Fountain is constructed upon the simple principle of natural intermitting springs; thus, the above Tazza is divided into two or more compartments, and pipes are laid from each to the several Dolphins below, the pipes being bent at the top. as soon as the compartments become quite full, and not till then, the contents will be rapidly drawn off through the Dolphins, and thus one or more of them may be seen playing, as their respective compartments become filled

AUSTIN AND SEELEY'S ARTIFICIAL STONE ORNAMENTS.

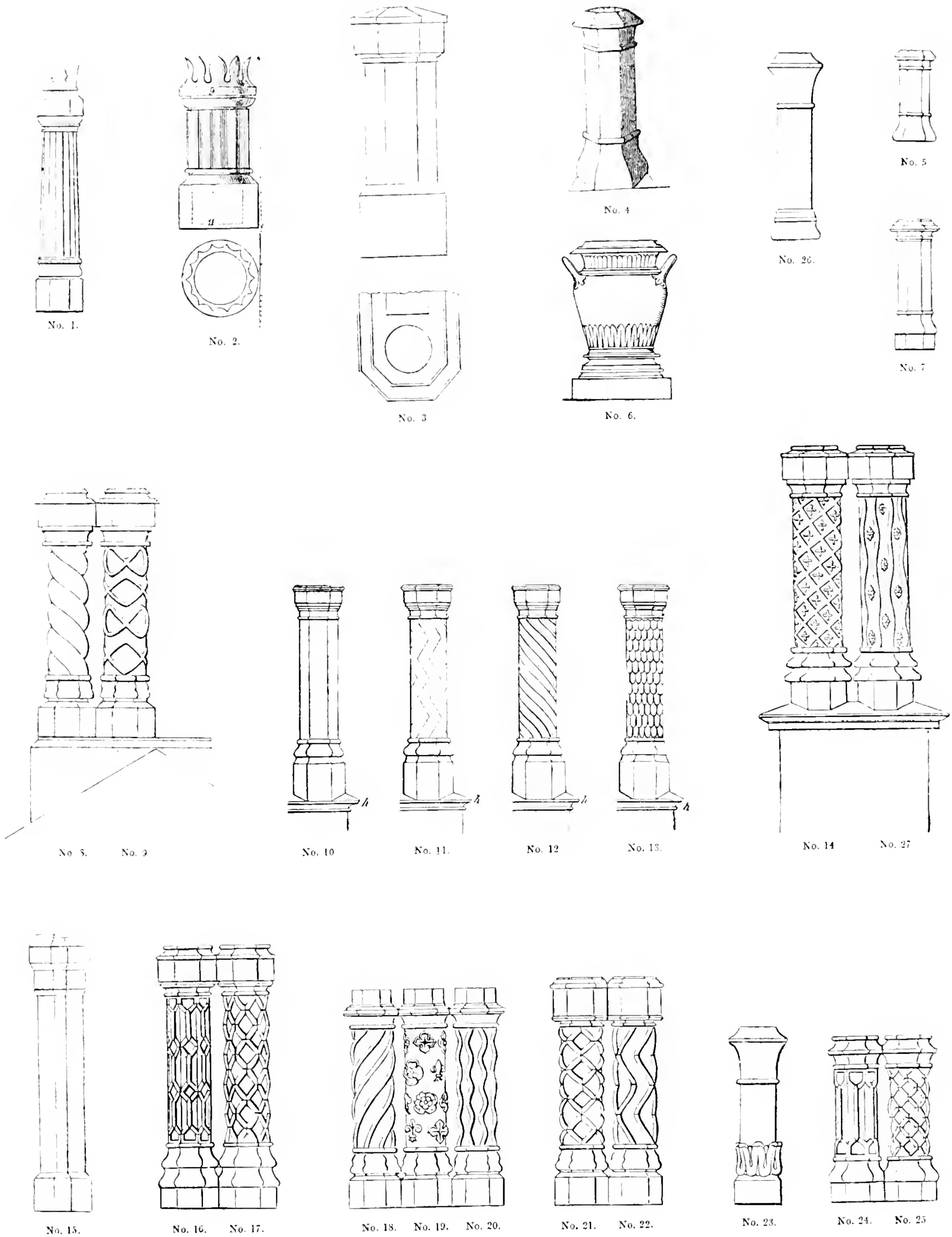
A Variety of Shells, from 25s. to £15 15s.



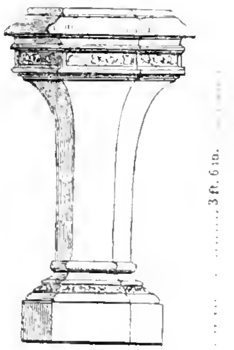
Set of Four Grecian Tazzas, lower one, 6 feet diameter, and lower Basin, with Enriched Rim, 20 feet diameter.

Antique Vase and Pedestal

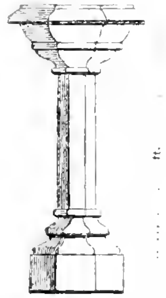
The following are selected from nearly one hundred varieties of Chimneys.



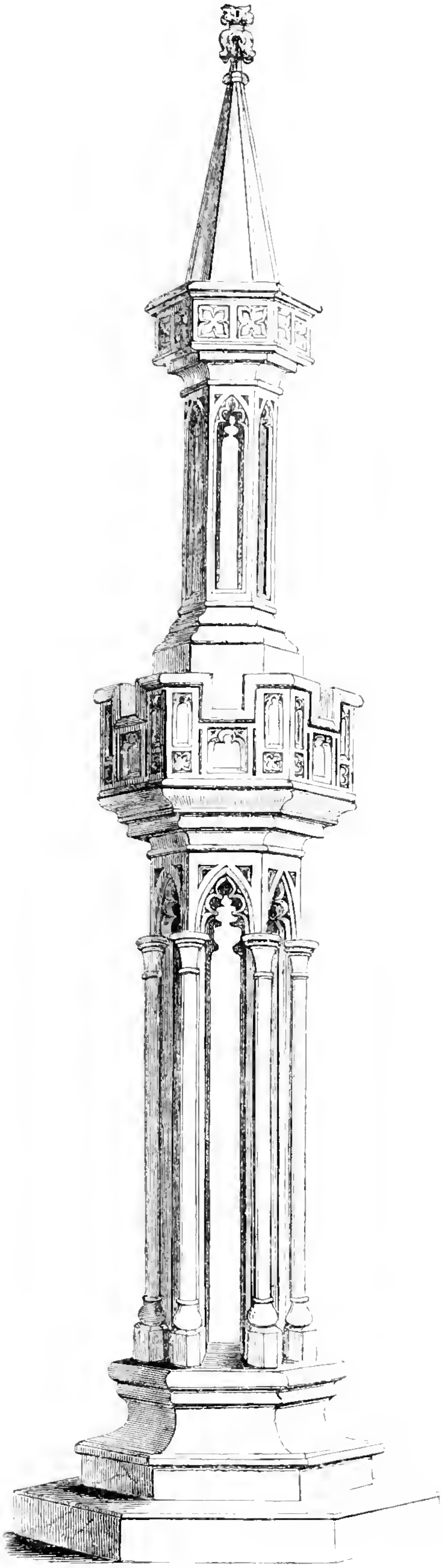
Fonts made to any Design.

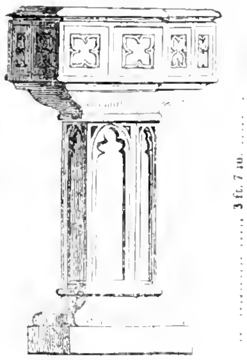


No. 552.—Font, with Wreath of Ivy Leaves.
No 553.—The same, without Wreath

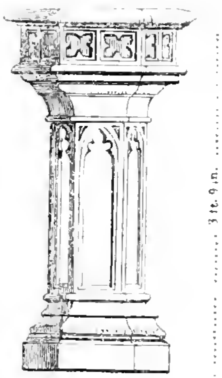


No. 556.—Plain Octagon Font.

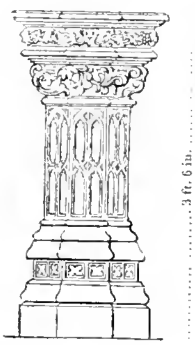




No. 559.—Gothic Font,
With large Top, for immersion



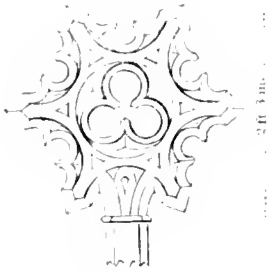
No. 557.—Gothic Font, with Perforated Shaft.
The same, with solid shaft.



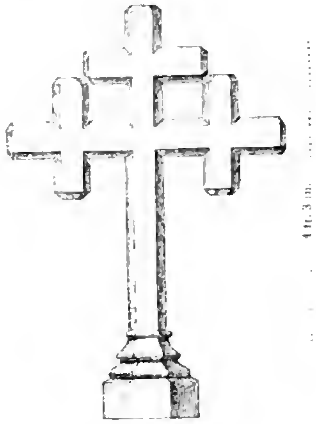
No. 547.—Rich Gothic Font
Designed from Henry VII.'s Chapel.

No. 563.—Early English Font

A. and S. have many other Fonts, slightly varied from the above.

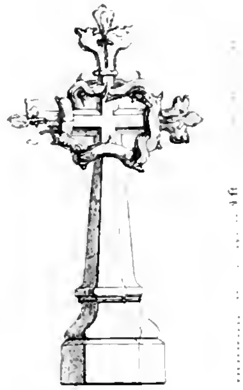


No. 543.

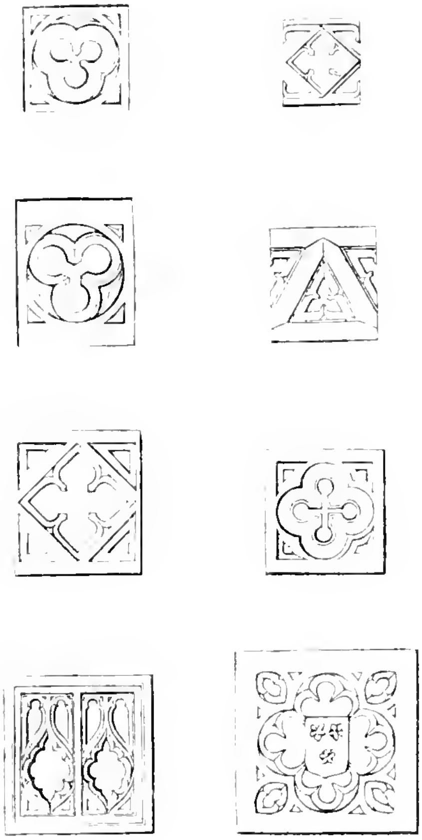


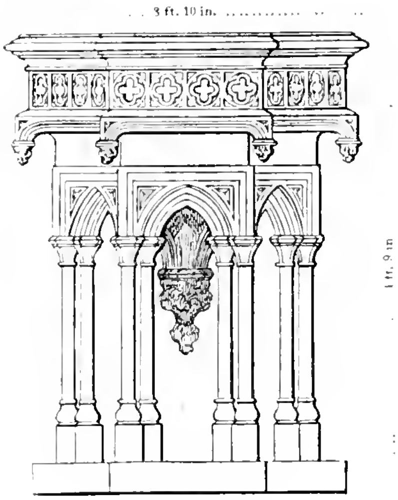
No. 539.

Also Five other Crosses.



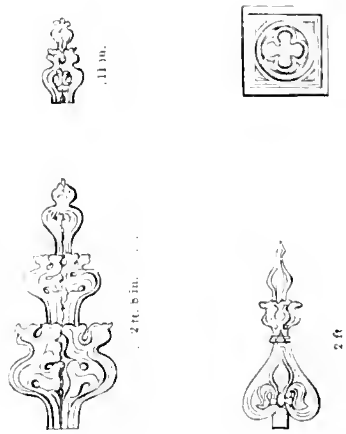
No. 540.





HEXAGON GOTHIC FONT.

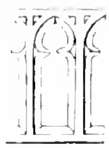
VERGE BOARD.



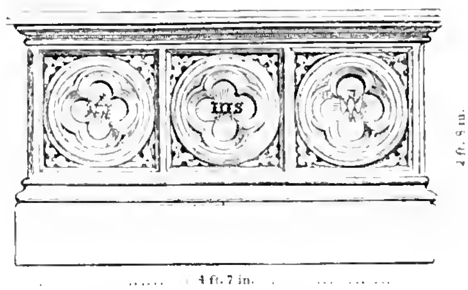
Also several other Finials.

(Drawn to inch scale.)

Nearly One Hundred Corbels and Brackets.

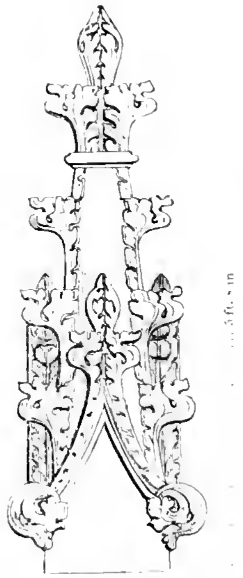


Also a Gothic Figure



COMMUNION TABLE (the ends plain).

Also the same size, with plain quatrefoil



Also other Pinnacles, 3 ft. 7 in.; 2 ft. 1 in.; 1 ft. 2 in

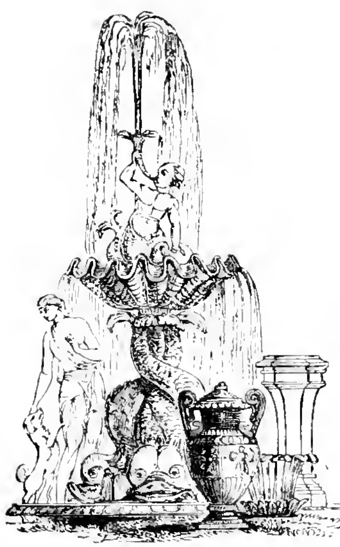
NEW AND USEFUL INVENTIONS, No. 3.

By Philotechnicos.

(With 8 pages of Wood Engravings.)

Having been prevented from continuing the series of papers which I had commenced in some of the early numbers of the Journal, and having been advised by some of my friends that notices of this kind were not only of value to the profession, as pointing out many things highly useful to them, and well deserving of encouragement, but also to the student and inventor by keeping a record of the attempts of others, I have been induced to resume my peripatetic exertions. My object being to bring before the world not only present scientific novelties, but many valuable inventions, which either lie dormant or are comparatively unknown, from their merits not having been sufficiently brought before the public; it is my intention to continue my visit to the studio, the workshop, and the manufactory, to search out and bring to light what I consider deserving of the patronage of the profession, at the same time that I rely upon their assistance to enable me satisfactorily to carry out my inquiries. Any communication therefore on these subjects, forwarded through the Editor of this Journal, I shall be happy to receive, so as to make this series of papers an interesting and valuable record of the meritorious exertions of ingenious individuals. From my present notes, I have contributed this paper, in which, if I have only been able to do justice to the labours of one, it must be remembered that it is not subjects which are wanting, but space.

AUSTIN AND SEELEY'S ARTIFICIAL STONE-WORKS, NEW ROAD, REGENT'S PARK.



The excellence of the composition, the symmetrical forms of the many elegant vases and tazzas, the well modelled and numerous architectural ornaments at this establishment claim particular attention. Those two noble vases the Borghese and Medici have been restored from the originals to their full size, and while without serious alteration they have been so managed as to pair together. The noted Warwick vase reduced to half the original size, and several others from the antique, are good specimens of the material and workmanship of this manufactory, in which may be found vases of all sizes and design, from the chaste Greek to the overwrought Maltese, many of which from their moderate cost may often be introduced with advantage.

The several fountains exhibited display, great taste and ingenuity: combinations of tazzas, dolphins, shells, and foliage, are cleverly contrived, with many beautiful devices for jets d'eau, which by their introduction will give great interest to the garden or conservatory, and tend much to enliven the scenery. Tazzas in gardens may be used for gold and silver fish, and serve as reservoirs for watering the garden. Much labour might be avoided if water were laid on to pedestals placed in several parts of the garden, and furnished with stop-cocks and flexible tubes concealed in them; the tube may be furnished with jets and roses for watering the plants with greater facility, and for the sake of ornament, a vase or figure should surmount the pedestal, and render it a pleasing object. Where a fountain is desired and water scarce, it may be so constructed as to use the same water over and over again, by raising it up into a vase or reservoir by a force pump hidden in the pedestal, or should there be a running stream in the neighbourhood, a small water-wheel or hydraulic ram might be applied by which the water can be raised to almost any height. The hydraulic ram is frequently used to force a portion of the waste water back again to the reservoir, which it will do by self-action. Most of these contrivances may be seen in action, Mr. Austin having well studied this interesting branch of his business, and expended great time in perfecting it.

The architectural ornaments consist of a variety of Gothic finials, pinnacles, crosses, panels, fonts, traceries, parapets, copings, and other decorations. The commissioners for building new churches might with advantage pay a visit here, and be convinced that ornament and economy may be combined, when they see that by the introduction of artificial stone, they would be enabled to enrich their buildings and avoid that barn-like appearance of many of the modern churches. To ecclesiastical buildings where repetition of ornament is so frequent, Austin and Seeley's artificial stone is well adapted, and has been applied with great success; its appearance, although only half the cost, is nearly equal to stone, and in point of durability far surpasses the softer kinds, and it is only equalled by the best Portland. All the dressings might be of this material, while by the building being faced with patent pressed malms in lieu of the frigid looking white bricks, now frequently used, a more cheerful appearance might be obtained and some architectural character.

There are many other ornaments suitable for building purposes, such as balustrades, columns, gate piers, porticos, brackets, trusses, &c., in all styles. The chimney-shafts are of great variety, and I would here beseech the architect to turn his particular attention to this subject, and to use his utmost exertion to reform those miserable looking specimens of ugliness, chimney pots, that now too frequently figure on the tops of houses, being usually of a most common place form, and as much disconnected from the style of the building as the figure of Nelson would be from a Corinthian column. They ought to be designed for what they really are—terminations to the building—and consequently finished as a sort of capping to the chimney shaft, and have some decided connection therewith. Such the Italians generally considered them, and thus has Mr. Barry very judiciously introduced them at the Reform Club House, where the chimney shafts are surmounted by a projecting cornice supported by trusses, and form truly ornamental objects, adding to the effect of the building rather than detracting from it, as in too many cases chimney shafts and pots usually do. Thus utility is reconciled with ornament, without any attempt to disguise what all the world knows to be connected with the greatest comfort in the house.

The flat roofs, floors and steps exhibited at these works deserve inspection; the front yards have been excavated, and workshops formed below the surface of the ground, and covered with this material, the lightness and strength of which is astonishing. The terrace roofing is laid with plain tiles in three courses, and rendered on the top, to the thickness in all of about four inches, carried over by arches slightly cambered springing from small brick piers, and tied by light iron rods, which form their chord line. These flats have an immense weight upon them, and are each, as it were, in one piece, having no perceptible joint, by which they are made completely water tight, at the same time that they can be easily cleaned. It may be well to remark that many flats have been formed of cement and tiles, and afterwards condemned as not being impervious to wet, this is, however, for the most part, a mistaken notion—it is true wet frequently makes its appearance, and is often seen dripping from the ceiling, but this almost invariably is caused by condensation—particularly over stables where the vapour, arising from the horses put in warm, ascends to the ceiling, is immediately condensed and falls in large drops. This may be avoided by firring out the ceiling, or laying the flat upon joists, and lathing and plastering the underside.

Tombs and monuments, with a variety of cinereal urns, are among the other objects of art, Mr. Austin being seemingly as desirous to provide for his dead customers as for his living ones. Many of these memorials of the dead are well adapted to produce an effect in those excellent establishments, the cemeteries, which are now being formed in all parts of the neighbourhood of London. I hope the day is not far distant when that disgusting and unnatural custom of burying in towns will be entirely dispensed with, as many of the churchyards have been proved to emit a vapour destructive to animal life, and to be the cause of much disease in densely peopled neighbourhoods, they are moreover most distasteful in their appearance, having their monuments and head and foot stones jumbled up together in heedless confusion. An English church-yard which ought to be the pride of the parish, particularly of the clergy, is mostly a jumble of broken stones, stiff graceless ledgers, and heaps of dirt, the whole in a miserably ragged condition disgraceful to a civilized nation.

There are several other subjects, figures from the antique, among which may be found a large assembly of gods and goddesses, animals, from the colossal lion to the petty lap dog—the famous dog of Alcibiades and the Florentine boar, standing most conspicuously—also many sphinxes and animals after Egyptian and Greek authorities; sun-dials and pedestals—the globe sun-dial is particularly interesting. But for space and time many more articles might be enumerated. I must now conclude, having been somewhat lengthy in my notice of this composition, with a view of forwarding its general introduction in place of stone, where economy is desirable, as it is capable of great variety of form and use.

For the purpose of illustrating this paper, I have through the kindness of Messrs. Austin and Seeley, selected several wood engravings from their book of designs, all of which are from specimens already executed.

[We hail with pleasure the renewal of our old correspondent's interesting papers, and will gladly second him in his laudable endeavour to serve the meritorious class he so warmly advocates.]—Editor.

"WESLEYAN CENTENARY HALL AND MISSION-HOUSE."

Letters of no mean size, affixed to the large, and, since its recent modifications, handsome building, which has attracted so much of the attention of the frequenters of Bishopsgate Street, thus announce to the public the new appropriation of the heretofore well-known City of London Tavern. The street front is of course the part most embellished, and with this perhaps the best has been done that it admitted of, and certainly a noble effect is produced, notwithstanding many disadvantages: for the old front being left standing, and the new being only an encasement of it, but little room for invention was afforded. The design is a Corinthian order, of four columns and two side pilasters, on a rather high basement: the four columns being surmounted by a well-proportioned pediment. The columns, which, of course, form the chief feature, are both bold and elegant, and have a very graceful outline: some persons might prefer them without the fluting, but we are inclined to think, that plain attached shafts at that height, would look heavier and less effective. The caps are about the best we remember to have seen, the volutes have a very graceful contour, and the leaves are bold and well relieved, and the whole of the sculpture, of which there is a good proportion, is executed with skill and decision. We are glad to see, from this instance amongst others, that enriched mouldings are again coming into use. The architect, whether from necessity or choice, has preserved all the original openings, and those in the ground floor, having been arched, are so still. This, though it gives the basement a character not quite in accordance with the Greek order above, yet produces a playfulness of line that, in our mind, greatly mitigates the defect, which, to the sticklers for antique precedent, will no doubt be serious: whilst, to another class, in which we may include ourselves, the adoption of the Greek, instead of the Roman or Italian style, will be a still greater offence. For we doubt if the delicacy of Grecian architecture can ever be made to accord with our climate and materials. The columns are somewhat close for their size, and the window dressings are consequently cramped: but this is rather the fault of the old building than of the new, and to the same cause it may be attributed that the parts are in better proportion than the whole. The breadth of effect would have been greatly increased by substituting columns for the two pilasters at the sides, but we presume they would have projected too far beyond the adjoining houses: a difficulty that must always occur in the streets of London, where houses jostle each other like persons in a crowd. With allowance for these defects, we should not do justice to the author (Mr. Pocock, architect,) if we did not state our honest opinion, that without attempting novelties, he has done the most his circumstances and style admitted.

The ceiling of the loggia is pannelled, and supported by four Doric columns fluted two thirds down. The rest of the interior, though handsome and substantial, is as plain in its architecture as at all accords with the magnitude of the structure and the elegance of the façade.

The general idea of the plan is perhaps the best part of the whole. Directly opposite the entrance gates of the loggia are the doors of the vestibule, and opposite these the doors of the hall, where a handsome flight of stone steps, with ornamental iron balusters, conduct to the corridor running straight forward, by the foot of an elegant circular staircase, to the anteroom of the secretary's office, so that the door of this anteroom is at the end of an avenue which continues in a straight line from it to the front entrance, each being visible from the other at a distance of more than a hundred feet. Rooms for other officers are provided directly over these, and are approached by the circular staircase before mentioned. Spacious offices for the transaction of the greater part of the business, are provided on each side of the outer hall, while those functionaries who require greater quiet, are provided for at the back part of the building. The flight of steps first mentioned, with the return flights leading to the Committee Room and the Library on the one pair of the front, occupy the lower part of a large covered area, from which light is obtained for the several apartments around. The workmen were still employed in the old Ball room when we were there, but, we understood, only in repairing and cleaning it, as it is to undergo no alterations, but to be fitted up with a platform and benches, and to be called "The Centenary Hall."

EPISODES OF PLAN.

(Continued from page 199.)

Whether intended for sideboard alcove, or other specific purpose, Recesses may be divided into *Simple* and *Compound;* and even those belonging to the first class admit of very great variety, exclusively of that which arises from embellishment. In their *plan,* for instance, they may be rectangular, or curved (and if curved either segmental or semicircular), or polygonal. In their *elevation,* towards the room, they may be arched or otherwise, with or without columns, &c. In *section,* they may be of the same height as the room itself; or *depressed* (that is lower); or *raised* (loftier); and if arched, in elevation, and curved or polygonal in plan may be covered by a *conch* or semidome. Neither is this all, since even this class may be subdivided into *Blind* and *Lighted* recesses. In the latter case various picturesque effects may be obtained according to the mode in which the light is admitted, which, however, should be so managed that the windows themselves are not visible, or else the recess assumes a different character, and becomes only a bay-window of the usual description, except it be that the window itself would not occupy the whole of it.

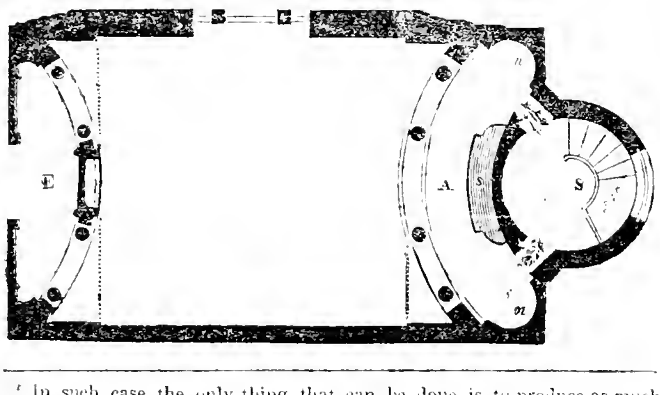
No instances occur to our recollection to which we can here refer at once as exemplifying some few at least of the forms and arrangements just pointed out: yet if this be so far inconvenient and unfortunate, it is also a tolerable proof that scarcely any thing at all has hitherto been done or even aimed at, as regards such features in internal plan; consequently that there is novelty of interior design in store for us, if we do but choose to adopt it, and to escape from that monotonous routine, and those *quotidian* forms to which architects now confine themselves.

Possibly there may be instances both in regard to recesses and other features of plan that might suit our purpose, and which may deserve to be brought forward by us as examples, were we but acquainted with them. Yet if they exist at all they are not generally known: there are no engravings of them in any publications, nor are any descriptive notices of them to be met with. To say the truth, peculiarities in design, of the kind here alluded to, are almost the very last which those who give us descriptions of buildings think of speaking of at all. Which, however, is the less to be wondered at, because architects themselves are, far more frequently than not, apt to pass them over in silence, even though such parts may happen to have cost them more thought and contrivance than all the rest of a design. In fact as regards interior domestic architecture, it very seldom happens that any thing more than two extreme points are taken into consideration: while nothing is aimed at in the general *laying out* of the plan, beyond what comfort, convenience, and facility of communication require,—nor is there always so much bestowed upon these as there might be; so also nothing amounting to architectural design is introduced into the separate rooms. Provided these last possess the negative merit of being satisfactory as to their dimensions and proportions, little besides is looked to for them, on the part of the architect. For all that gives them life and interest they are indebted to the decorator and upholsterer, or to the works of art which they may contain. In by very far the greater number of cases no attempt is made to obtain aught of decided architectural character, or of that kind of expression and effect, which may exist before such things as hangings and draperies, furniture and pictures are added. We are very far from despising or undervaluing such matters as these last; yet we certainly regret that attention should be too exclusively confined to them, when they are of subordinate importance, inasmuch as they admit of change and improvement at any time, whereas if architectural effect has been disregarded in the first instance, it is not always easy—sometimes scarcely possible to supply it afterwards, without considerably altering the building itself, and breaking up the original plan. On this account therefore it is highly important that the design should be carefully considered and strictly scrutinized in order to ascertain whether besides being satisfactory as regards convenience, and the required accommodation, it also provides a good deal of architectural effect throughout the various parts of it. Undoubtedly the present system has its conveniences: it spares a great deal of trouble—that is, of study and thought to the architect: but then it also cuts off the opportunity of displaying talent and invention upon a class of subjects, where, if allowed to be exercised, they would have free scope.

One obvious source of variety in plan, is to break the sameness of the quadrangular forms of rooms, by some kind of alcove or deep recess, constituting a distinct compartment, and further conveying the idea of extension, so much space being apparently added to what would else be the limits of the room, even although it should in fact be purposely taken from it in making the plan. Independently of all other effect such parts are almost sure to produce a good deal of pictorial expression in the ensemble of an apartment, by the effect of light and shade attending them. They may also be made to contribute very much to the air of habitableness and comfort; as many articles of furniture, or for mere ornament, may be arranged within such embayed compartments without at all crowding up or interfering with the rest of a room. Cabinets, stands for bijouterie, book-cases, ottomans, flower-stands, and other things of that kind, may there be tastefully disposed, so as to be at hand, and so as to form a striking and pleasing group of objects, and produce a certain degree of contrast as it were: not that contrast is indispensable, or indeed, in every case, adviseable. How far it is so, or the contrary, must depend upon the circumstances of the individual design, which cannot be prejudged according to any general rules, or directions.

Much may be made of an alcove or deeply embayed recess in a room, let the style of architecture adopted be what it may; and in any application of the Gothic something of the kind becomes requisite, in order to give character, particularly in a mere four-sided room, without either bay-window or any breaks in the walls.* In a room of the kind already built, or where the plan itself will not admit of a recess being formed, without interfering with some other room, or else occasioning some other difficulty, the appearance at least may be obtained by sinking a shallow arch-headed compartment on one of the sides, and decorating it with panelling and tracery filled in with pieces of mirror, so as to resemble an open-work screen. There is another point as regards Alcoves and Recesses, not yet mentioned, but which deserves to be considered, although it is one that does not admit of any positive instructions respecting it being laid down. We mean the relative size of the alcove in comparison with that of the room itself, and also the size of the opening which unites them. Independently of every thing else, here alone almost endless diversity may take place. Much also will depend upon the situation of such a recess, and whether there be only a single one, or more in the same apartment.

For want of positive examples, much of what we have hitherto said, may have been thought vague and obscure, and so far—if not otherwise—unsatisfactory. We now proceed, therefore, to give, as one of our Episodes, a plan for a Dining Room, having a rather spacious sideboard-alcove, communicating with which is a staircase exclusively for the attendants, and for serving up dinner;—the convenience of which is so obvious, that it is unnecessary to point it out.



* In such case the only thing that can be done is to produce as much effect as possible by means of the fittings-up and furniture, into which the spirit of the style must be carefully infused: or if not it is better to get rid at once of *every* indication of the style in such a room, concealing the upper part of the windows, as much as possible by draperies, should there be arched compartments of any kind in the heads of those apertures.

It will be evident at first sight that we do not offer this as one of the simplest arrangements of the kind, because it may in some respect be termed rather complex, and is, besides, very remarkable—some will, doubtless, say exceedingly capricious—for the form given to the ends of the room, those elevations being not only curved, but convex in plan. Should it be asked of us why we have chosen to bring forward so very unusual a circumstance, such question ought to suggest its own answer. Whether such novelty in the plan be judicious,—whether concave instead of convex ends would not be greatly better, is what the reader must determine for himself. But as it was our intention to give an instance of an alcove curved convexly towards the room, it is pretty evident that by making it otherwise than it is, we should have defeated our purpose.

Of the effect attending such peculiarity in the design, most of our readers, we presume, will have no difficulty—in judging from the plan, —that is as far as plan alone is concerned, independently of the mode in which it may be filled up. We ourselves are persuaded the effect would be pleasing, as well as strikingly novel. Owing to its colonnade being curved convexly, both that and the Alcove, A, itself, are brought forward more conspicuously. The opposite end of the room is similar in its general elevation, except that the middle intercolumn is filled up by a pier containing the fire-place, whereby the space E, or entrance alcove, serves as a kind of lobby (though not an enclosed one) to the room, and the chimney pier as a screen before the door, facing which last, there might be a blank door filled with a mirror, so as to give the effect of greater space on first entering. In this case the Dining-room is supposed to communicate immediately with the vestibule, consequently some kind of screen, (where one can be obtained, that shall rather aid than at all prejudice the architecture of the apartment) is desirable. But should the Dining-room be preceded by an Ante-room, it then becomes a question whether it would not be adviseable to alter that part of the plan, placing the chimney-piece opposite the window, and making the colonnade at E precisely similar to that at A. Owing to their bowing out towards the room, those colonnades or end elevations, certainly abridge it in some degree, yet not at all more than the plan will very well bear. While the space itself is in some measure reduced, the appearance of spaciousness is kept up. It is true such loss of space as is here occasioned at the angles of the room, can very seldom be afforded; but then, neither do we recommend a plan of the kind where it would be quite out of character with the rest of the house.

With respect to the alcove A, we have little to remark, except that the doors are so placed that when opened by the servants nothing can be seen of the staircase S. Should the sideboard *s* be insufficient, there might also be lesser ones in the two recesses *n n*, which if not required for that purpose, might have candelabra placed in them. Without at all altering the lower part or floor plan, an entirely different idea might be adopted for the upper portion at about the height of seven or eight feet, breaking through the wall above the sideboard *s*, so as to admit a view into the circular space over S, which would then become a small rotunda or upper recess, seen beyond the other. In such case there would of course be a ceiling between it and the staircase beneath. This recess would be domed, and have an eye or skylight, which should be filled with warm-tinted glass, so as to diffuse a sunny glow both over that upper recess and the alcove itself, and thereby greatly enhance the effect of the whole of that compartment as seen through the columns. The same effect might be preserved of an evening (before which a dining-room, if reserved exclusively for the purpose of one, is seldom used) by lighting it with gas on the outside of the skylight. We will further suppose this recess to be occupied by a statue (a mere cast) placed in the centre, and elevated upon a pedestal of such height that the whole of the figure would be visible from the middle of the room, if not nearer. An elevated recess of this description, might be made to answer the purpose of a music gallery, when one is required. We need not enter into further explanation or remark, as we have said enough to show what variations this plan admits of, accordingly as the section raised upon it is treated.

By no means do we pretend to say that the above Episode can be introduced into every or any plan; most certainly not. It seems best adapted for the rear of a house, in continuation of the ground floor; and supposing it so situated, and to have no other room above it, the apartment could be lighted by a lantern: that however must depend upon circumstances of locality, and whether sufficient light could be obtained from a side window according to the plan.

(To be continued.)

ON THE ARCHITECTURE OF WISBY IN THE ISLAND OF GOTHLAND, IN THE BALTIC SEA.

By John White, Esq., Architect.

Read at the Royal Institute of British Architects; March 8, 1841.

The perusal of the passages in Mr. Laing's Tour in Sweden which relate to the architecture of the city of Wisby,* have induced me to make the following observations as to the origin of that mode of the construction of edifices commonly called Gothic, and to consider the existing remains of that city, for which purpose I have availed myself of some northern connexions in obtaining some further information beyond what is already before the British Institute, and feeling that Mr. Laing has much advanced the knowledge of architectural antiquity by having recommended to the attention of the public, these very early, if not the earliest, examples of Gothic construction, I submit the following remarks.

The well known observation of Sir Christopher Wren (Parentalia, page 306,) "that what we now vulgarly call the Gothic, ought properly and truly to be named the Saracenic architecture refined by the Christians, which first of all began in the East after the fall of the Greek empire, by the prodigious success of those people that adhered to Mahomet's doctrine, who out of zeal to their religion, built mosques, caravansaras and sepulchres wherever they came," is to be opposed by examining the structures of the 11th century in those parts of Europe, especially the northern, where the Saracens never came, and this I trust will be manifest, independently of other proofs, from the examination of the architecture of the remains of those churches of Wisby so referred to by Mr. Laing, which are herewith communicated so far as the drawings of them are published.

The birth of Mahomet was in the year 569, and the conquests of the Saracens followed with rapidity the commencement of the 7th century, when the Saxon style of building is supposed to have been, in the northern portion of Europe at least, the prevailing form: of this, however, in England, we have few examples; Stukeley Church in Buckinghamshire, has been quoted by most writers as the most ancient and perfect example of the pure Saxon: it has certainly nothing Saracenic about it, excepting that all the arches are of a circular character, in common with the Roman and Saracenic, whereas what is denominated the gothic arch is universally of two or more centres describing portions of circles meeting at a point.

It may, perhaps, assist the inquiry to refer to the periods of the northern irruptions and conquests, which are as follow:

Their power in Italy, England, &c.	Began A.D.	Ended A.D.
Goths of Scandinavia	250	382
Saxons	366	not ended
Ostro Goths	400	568
Visi Goths	462	711
Lombards	570	774
Danes	787	1069
Normans	1016	not ended

The buildings at Wisby are admitted to have been constructed at the following periods:

11th Century. Churches.	A.D.	12th Century. Churches.	A.D.
All Saints	1030	St. Hans	1130
Holy Ghost	1046	St. Catherine	1160
St. Lawrence	1046	St. Gertrude	1167
St. Drotten	1086	St. Maria	1190
St. Peter	1088		
St. Michael	1090		
St. Nicholas	1097		

Of the Christian religion the following orders were founded:

	A.D.
Knights Hospitalers	1100
Augustine Canons	1105
Cistertians	1128
Knights Templars	1146

The following extracts from Grose's Antiquities may further elucidate the subject. See preface, page 63.

(Stowe's words on the Cathedral of London.)

"In the year 1087 the church of Saint Paul's (in London) was burnt with fire, and therewith most part of the city, Mauricius, then Bishop, began therefore the new foundations of a new church of St. Paul, a work that men of that time judged would never have been finished, it was then so wonderful for length and breadth, as also the same were builded upon arches, or vaults of stone, for defence of fire, which was a manner of work before that time unknown to the people of this nation, and then brought from France, and the stone was fetched from Caen, in Normandy, &c.

This, doubtless, is that new kind of architecture the continuer of Bede (whose words Malmsbury hath taken up) intends, when, speaking of the Norman income, he saith, "You may observe every where, in villages, churches, and in cities and villages, monasteries, erected with a new kind of architecture."

And again, speaking doubtfully of the age of the eastern part of the choir of Canterbury, he adds, "I dare constantly and confidently deny it to be elder than the Norman conquest, because of the building it upon arches, a form of architecture, though in use with and among the Romans long before, yet, after their departure, not used here in England, till the Normans brought it over with them from France. (Sommer's Antiquities of Canterbury.)"

Grose further observes, page 65, (on Saxon architecture):

"This was the style of building practised all over Europe; and it continued to be used by the Normans after their arrival here, till the introduction of what is called Gothic, which was not till about the end of the reign of Henry the First, so that there seems little or no grounds for the distinction between the Saxon and Norman architecture. Indeed, it is said, that buildings of the latter were of larger dimensions, both in height and area, and they were constructed with a stone brought from Caen in Normandy, of which the workmen were particularly fond; but this was simply an alteration in the scale and materials, and not in the manner of the building. The ancient part of our cathedrals are of this early Norman work."

That building was carried on in northern countries. Jonas Ramus states, in Norwegia Antiqua et Ethnica, pages 89 and 90:

That Dronthiem was built by Olave Tryggo, who became king of Norway, A.D. 996, and Bergen was built by Olave Harald Kyrre, who completed the Cathedral of Dronthiem began by Magnus the Good and his father. Olave Harald Kyrre was buried at Dronthiem, A.D. 1093. Magnus the Good died 1047.

Roger de Montgomery built Ludlow Castle after the Norman Conquest. In the enceint there existed a circular entrance to a chapel now destroyed; this circular entrance has considerable resemblance to that of the Temple Church in London. The drawings of Ludlow Castle made in 1774, show this building, and I have made a drawing of the plan of the Wisby Churches to the same scale as that of the Temple Church, in order that their dimensions may be compared.

The period of the introduction of arches described with more than one centre, is the matter of doubt; but it can hardly be conceived that a general appellation should be used without any foundation. The Gothic monarchy in Spain was destroyed in the beginning of the 8th century by the Saracens, and of the many buildings erected by them, the arches are all of a circular character, not concentric, but of more than a semi-circular form in the void.

The Cathedral of Barcelona was began in 1299.
That of Tarragona about - - 1200.

The monastery of Poblet, which in the interior much resembles the Wisby churches, in 1149.

It is not impossible that at the time the city of Wisby flourished, it had overland communication with India, as the troubles of the Eastern Roman Empire rendered the Mediterranean and its territories unsafe for merchandise, and as there exist in India many buildings constructed with arches even of four centres, it is possible that the Gothic arch may thence be derived, yet the Indian arches resemble more the vaultings of the Tudor style, and the most perfect of them are as late in the reign of Schah Abbas, who died in 1629.

Bishop Warburton, as quoted by Grose, says, our Norman works had a very different original from Saxon builders, who took their ideas from the buildings of the Holy Land, for when the Goths conquered Spain, they struck out a new species of architecture unknown to Greece or Rome, upon original principles, and ideas much nobler than what had given birth even to classical magnificence.

It is difficult to reconcile the style of our finest cathedrals as to their internal ranges of coupled columns with the groves of northern countries, because the fir seldom assumes, though the planted elm does, the general character of ribbed arches, but there is a natural progression of form proceeding from a repetition of the squares or round column to the octagonal, and afterwards to the coupled column, and the ribbed arches springing from the octagonal exist in the beautiful remains of St. Catherine's church at Wisby.

* Pages 304, &c. printed by Longman and Co. 1839.

In the bridge of Martorell in Spain, there are arches both of the semicircular and the pointed form. From the drawing in De la Borde's work it appears that the gothic arch (which is of 133 French feet span) is an enlargement of the water way, for the stones of two circular arches where it exists, are remaining, and exhibit the ancient work which was probably Roman. The arch is from the highest part of the soffit to the water 70 French feet. De la Borde does not say when this arch was constructed, but its magnitude renders the time of its being built a matter of interest in a question as to the origin of its form, for it would be wonderful if the Saracens had employed this mode of building, de novo, when an arch of less elevation would have better answered the purpose of a public way, and their Arabian or even Moorish origin was not likely to lead them to construct bridges of great span and height over the water way, there being little necessity for such edifices in their own country.

The first crusade was subsequent to the Council of Clermont in 1095, and it was at this council that the banner of the cross was assumed, from this assumption of the form of the Latin cross, it is probable that the plan of most of our cathedrals was adopted. None of the churches of Wisby have this shape, although there exist the repeated pillars, arches, and groins. The most ancient churches, viz. the church of Stukeley, that at Cambridge, and those of Northampton and the Temple, with the chapel at Ludlow, are totally different.

When the slender pillars were used it became necessary to employ the buttress, Mr. Samuel Ware* has successfully shown their importance, there is little appearance of their employment in the buildings of Wisby, where the pillars are of greater bulk and better calculated to support stone vaulted roofs. Stone groins certainly existed in this country at an early period, but they are confined to the crypts, and particular parts of buildings. The church of Stukeley does not exhibit any appearance of a stone arch in the main part of the building which has a wooden roof, and the Temple church has a wooden roof both over the circular part and the body, both which roofs are extremely ancient, and verging into great decay, though of the finest oak.

It may be deserving of inquiry as to where the largest and most perfect groin exists, domes are of greater antiquity, perhaps the groin of Julian's palace at Paris is that best known in this part of Europe.

I will conclude these observations by referring to the correspondence which has taken place relative to the ruins of Wisby with Major Gerss of Stockholm, by which it will appear that for the sum of 80*l.* numerous drawings can be supplied. The printed documents which were procured by my son at Stockholm, accompany this paper, together with a translation of a short history of Gothland and Wisby, the general map of the country will exhibit the situation of the island and the city, and the appendices afford various authorities of its antiquity and destruction. The lithograph plan of the city of Wisby will show the situations of the various churches and Wisby Klingwalls. Parts 1 and 2 will exhibit the buildings which have formed the subject of an intended work, but which has not gone beyond these two portions of it. It is to be hoped that it will be continued and improved upon.

January 30, 1841.

* See his work, "A Treatise on the Properties of Arches and their Abutment Piers." By Samuel Ware, Architect: London, 1809.

A FEW OBSERVATIONS ON PALLADIO.

ADDRESSED TO MR. CROKER, &C. &C.

I had hoped to have pursued a train of thought upon Palladio and his school, without startling one critic into life. Like a young and cautious mariner, I ventured not far into the open sea, because I knew critics were afloat, and because I knew them armed with every classic weapon of attack. These gentlemen, like pirates grown old in their ugly warfare, are ever to be found on the ocean of taste, whilst, with weapons sharpened upon some old ruin, and with prejudice for a war cry, they hunt for every modest searcher after the beauties of Italian art. It was for this reason, perhaps, that a partiality for Palladio seldom tempted me to an invidious comparison; I merely admired a man of original daring, and left a crowd of copyists and purloiners from Athens and Rome to interpret at their pleasure.

A sail, however, is astern, bearing up the gallant Mr. Croker, who, with spy-glass in hand, finds my rigging defective or my vessel weak. His frown is on me for my late remarks upon Campbell and Palladio. He thinks, however, because I cited no examples to support my fancies, that the guns of defence are few, and so his face changes into smiles, and his laughing caution to surrounding friends is "risum teneatis!" Now this amusing merriment in the critic amuses me, and were it not for the singular attitude of his pen at the conclusion of his letter, I should have passed from his comment with a smile. Mr. Croker's pen is made to suspend itself in threatening shape over me, to alarm and intimidate my own. Perhaps, however, it may be that the awkward little feather which Mr. Croker handles, is conscious of its intended misappropriation, and very properly shocked at the injury it is likely to inflict upon the fame of Palladio, forsakes his hand. But why does the conscious sensitive thing hang over me? Perhaps to warn me of a future attack. Mr. Croker evidently imagines his quill an object of terror, and so makes no small effort to direct me to it; but upon close inspection I perceive the little creature too harmless to disturb, and too innocent to vex.

I do admire Palladio, and if my partiality is a passion, it is a passion more like sentiment than the passion of a childish instinct. I admire Palladio for his daring and originality, for his starting up in the midst of error, when art began to grow fanciful and trifling, for his care in shunning the evils of his time, and borrowing from the beauties of the past. To test Palladio too severely by the models of antiquity, is unfair and impossible, because the modification and change necessary to the structure destroy the parallel. To test, too, Palladio by the mean experiment of subordinate variations, is ungenerous, because Roman architecture itself, imposed with its parts, much more than it charmed by its minutiæ. Palladio's great achievement, too, was the adaptation of the orders to domestic habitations, in which antiquity became subservient, and in which the whole array of detail was subsidiary. One great reason why many condemn Palladio is, because he leads them occasionally into error, and too loosely scatters his decoration. Tell them of a palace or a church designed by him, and they will tell you of an incorrect member or a broken tympanum: or speak to them of originality, and they will shout for a precedent. The source of beauty, however, may have been misunderstood, and the elements of grandeur may have been mistaken. Beauty belongs to no particular form, but to the harmony of relations blending in that form; and the same principles which adjusted the lovely outlines of antiquity, may enter into the composition of larger and grander objects. Nature supplies such innumerable varieties of beauty, such apposite changes, that I wonder *some* cannot perceive the lesson she would teach. These few remarks, arising out of Mr. Croker's observations, are all I wish at present to offer. I have not gone coolly into a digest upon Palladio, because at present I have been alluded to merely in the language of general disagreement. My reflections are therefore mere generalities, but capable, I hope, of assuming a more connected form, should the objections of a critic assume a sober shape and demand it. I do not, however, allude to Mr. Croker so much, for his reflections are generally sound and liberal; I rather fancy before me, as I write, the enemies of Palladio's style to whom he addresses his "risum teneatis," and in whose judgment nothing but the antique can please.

April 13, 1841.

FREDERICK EAST.

ENGINEERING WORKS OF THE ANCIENTS, No. 4.

The last author from whom we took was Polybius, who lived B.C. 124, the one from whom we now select, Xenophon, preceded him in time, living 400 B.C.

PERSIAN ENGINEERING.

CANALS—TIGRIS—INUNDATION—IRRIGATION.

It is in those works which treat of Persia and Egypt that we find the most information as to engineering, for the Greeks, as we have before explained, from geographical position, having no considerable rivers, were not called upon to execute those long canals and large bridges which were of vital necessity to their eastern and southern neighbours. It is therefore in Asia and Africa that we must look for the schools of engineering, of which the practice has been transmitted to us through the Greeks and the Romans. When quoting from Herodotus we before mentioned the Persian canals, and we now take from Xenophon, commander of the Greek army, what he says on the subject in his work called the Expedition of Cyrus, or Retreat of the Ten Thousand: it being our purpose not to collect what has been said on each individual subject, but to abstract from each author seriatim his separate testimony, so as to form in these essays a kind of diplomatic collection or chartulary, from which the student may derive his own materials. Of the plain of Babylon, our author says,* that in it are four canals derived from the river Tigris; being each one hundred feet in breadth,

* Book I.

and deep enough for barges laden with corn to sail therein; they fall into the Euphrates, and are distant from one another one parasang, having bridges over them. With regard to the origin of these canals, Arrian differs from our author, as he says that the canals which run from one to the other are derived from the Euphrates and fall into the Tigris.—Strabo and Pliny confirm this, assigning as a reason for the construction of the canals, that they are cut to receive and distribute the increase of water arising from the melting of the spring snows.

Clearchus† whilst in the same district on his retreat was much embarrassed by meeting with canals and ditches full of water. Clearchus suspected that as this was not the season to water the country, that the king had ordered the waters to be let out to impede the Greeks on their march.

About a day's march from Babylon the Greeks made in two days a march from Babylon, eight parasangs and passed two canals, one upon a bridge, the other upon seven pontoons.—Xenophon again says that these canals were derived from the Tigris, and that from them ditches were cut that ran into the country, the first broad, then narrower, which at last ended in small water courses, such as were used in Greece to water a kind of grain called panic.

To the history of these canals we shall be able to derive many contributions when we come to the works of Strabo, Pliny, and Ammianus Marcellinus. The boats of the Babylonians, as described by Herodotus, were peculiarly adapted for the navigation of these canals. At present the canals are choked up.

BRIDGES.—PASSAGE OF RIVERS AND CANALS.—PHYSCUS.

In the course of the expedition and the retreat, the Greeks came to many broad rivers, which in general they passed by fording, or by crossing on rafts: near Babylon they were able to avail themselves of the bridges of which they mention several. On one occasion coming to the Tigris‡ they found the river very deep, when a Rhodian proposed the following plan. "I shall want," said he, "two thousand leather bags—I see here great numbers of sheep, goats, oxen, and asses: if these are flayed, and their skins blown, we may easily pass the river with them.—I shall also want the girths belonging to the sumpter horses: with these I will fasten the bags to one another, and hanging stones to them, let them down into the water instead of anchors, then tie up the bags at both ends, and when they are upon the water, lay fascines upon them, and cover them with earth. Every bag will bear up two men, and the fascines and earth will prevent them from slipping." The generals considered this proposition ingenious, but were afterwards enabled to get out of their difficulties another way.

In the First Book bridges are mentioned over four canals near Babylon, each a hundred feet long: in the Second Book we have a reference to another; and in the same book we find it stated that over the river Physcus, one hundred feet broad, a bridge was placed communicating with a large and populous city called Opis. When Clearchus came among the flooded canals, he passed them by temporary bridges made of palm trees.

WALL OF MEDIA.

In the Second Book we have mention of the Wall of Media, which was built with burned bricks laid in bitumen: being twenty feet in thickness, one hundred feet in height, and as it was said twenty parasangs in length, and not far from Babylon.

CITIES AND FORTS.—WALLS.—LARISSA.—MESPILA.

Larissa or Resen is described in the Third Book as a large uninhabited city near the Tigris, anciently inhabited by the Medes, the walls of which were five-and-twenty feet in breadth, one hundred in height, and two parasangs in circuit; all built with brick, except the plinth, which was of stone, and twenty feet high. One day's march from thence the Greeks came to a large uninhabited castle near a town, called Mespila, formerly inhabited also by the Medes. The plinth of the wall was built of polished stone full of shells, being fifty feet in breadth, and as many in height. Upon this stood a brick wall fifty feet also in breadth, one hundred in height, and six parasangs in circuit.

PYRAMID OF LARISSA.

Close to the city of Larissa, says Xenophon, stands a pyramid of stone, one hundred feet square, and two hundred high, which seems to have been hollow.

GREEKS.

The observations of Xenophon as to Greek engineering we extract from his history of the affairs of Greece. In his Expedition of Cyrus however he alludes to the mole of the harbour of Byzantium, and to his forcing the Ionian Greeks to repair the roads through their cities preparatory to the march of his army.

QUARRIES OF THE PIRÆUS.

The quarries of the Piræus (Book 1st,) were in Xenophon's time wrought by Syracusan prisoners, who were confined there, and who made their escape by digging themselves a passage through the rock.

CAPTURE OF MANTINEA.

In the course of the Peloponnesian war (Book 5th) Mantinea was captured by the Spartans under Agesipolis. Besides the usual works of digging a trench, and constructing a wall, he dammed up the river, which was a large one, running through the city. The channel being thus dammed up, the water swelled above the foundations of the houses and of the city walls. The lower brickwork (being probably of raw bricks) was soon rotted by the wet, and shrank under the upper buildings, by which means the city walls cracked, and afterwards were ready to tumble. For some time they underpropped them with timber, and made use of all their art to keep them from falling. The Mantinians ultimately consented to demolish their walls.

BRIDGE OF SELLASIA.

A bridge is mentioned in the Sixth Book, at Sellasia leading to Sparta, but no description is given of it.

DOCKS OF GYTHEUM.

The docks of the Spartans (Book 6th,) were at Gytheum.

PUBLIC INNS AT ATHENS—SHOPS, &c.

In his pamphlet on the revenue of Athens, Xenophon alludes to the public inns for the use of strangers, he also recommends the building of greater numbers of shops, warehouses and exchanges for common retailers, relying upon it as a good means of revenue.

REPAIRING PUBLIC BUILDINGS BY CONTRACT.

Xenophon also in this pamphlet slightly alludes to the custom which the Greeks had of letting out the building and repair of their temples to private undertakers also mentioned by Athenæus and Herodotus, B. 5, C. 62.

† Book 2nd. ‡ Book 3rd.

DOUBLE OFFSET PLOTTING SCALE.

The Silver Medal was presented by the Society of Arts to Mr. James G. Austin, 36, Grafton Street, Gower Street, for his Offset Plotting Scale for the use of Civil Engineers and Surveyors.

The Double Offset Plotting Scale consists of two perfectly parallel graduated scales, whose distance is equal to the length of the offset scale which runs on rollers between them. The parallel scales and the offset scale are graduated to suit the views of the user. The pieces connecting the ends of the double scale are hollowed out to receive weights, armed with points to enter the paper, which hold the instrument in its place, and prevent its being shifted while in use; and from the centre of each of these connecting pieces projects an index; the points of these indices and the zero of the offset scale being always in the same straight line, which is, of course, the line from which the offsets are to be measured.

BRIDGE OF THE HOLY TRINITY.

In constructing the curve of the arches of the bridge of the Holy Trinity, according to the geometrical solution given in the last number of the Journal, I found the arcs EH, HH, make an angle at H, in consequence of the centres GI not being in a right line with the point of intersection H. This fault must have been overlooked by the author of the paper, and I take the liberty of thus troubling thee in order that the error may be corrected. May I also ask what advantage an arch upon this construction would have over a semi-elliptical one of the same versed sine (besides the simplicity of striking out the curve)?

I am, respectfully,
INEXPERTUS LOQUENDI.

Neath, 4th month, 12th day, 1841.

IRON STEAM VESSELS,

Built by Messrs. Wm. Fairbairn, and Co., of Millwall, London.

Date.	Name.	No.	Tonnage.	Horse Power.	Length on Deck.	Beam.	Depth of Hold.	Remarks.
					ft. in.	ft. in.	ft. in.	
1830	Lord Dundas, Twin boat.	1	41	18	68 0	11 6	4 0	An experimental boat, built for the Forth and Clyde Canal Company, with an engine on the locomotive principle, and light draught of water.
1831	2d Lord Dundas	2	44	20	68 0	12 0	6 6	This is the first iron boat that ever went to sea, as she made the voyage from Liverpool to Glasgow. She was built for the Forth and Clyde Canal Company with paddle-wheels on the quarters, and was employed as a coasting trader to Grangemouth, and the adjoining ports.
1831-2	Manchester	3	70	30	70 0	15 0	8 0	This was the second vessel that made a sea voyage; she was out in a severe gale in the month of February, 1832, and behaved to the admiration of all on board.
1832	Canal Boat	4	$10\frac{1}{2}$	—	60 0	6 0	4 0	
1833	La Reine de Belge	5	64	24	73 0	14 0	6 6	Built for a company at Bruges, and made the voyage from Liverpool to Ostend, and is now employed on the Scheldt.
1833	Minerva	6	108	40	98 0	15 6	7 0	Built in sections for the Lake of Zurich in Switzerland, sent in parts from Manchester to Hull, and there reconstructed, and made the voyage from Yarmouth to Rotterdam in 33 hours; steamed up the Rhine to the falls, and then taken to pieces, and carried overland; and again reconstructed on the banks of the Lake.
1834	Railway	7	164	50	110 0	18 6	8 0	Two packet boats from Selby to Hull, each drawing about 3ft. 3in. water. These boats have been plying with great success for the last 5 years upon the Humber; are still perfect, and quite free from oxidation.
1835	L'Hirondelle	8	171	60	115 0	13 0	8 0	
1836	Ludwig	9	$176\frac{33}{94}$	40	120 0	17 0	8 0	Built for the Lake of Constance, and sent out in sections. She has proved a good and fast boat. This vessel was the first built at the new premises at Millwall.
1836	Little Dreadnought	10	14	—	—	—	—	Built after the model of an East Indiaman's long boat, and has been in constant service on the river, carrying iron and other goods, and heavy castings, for 4 years, without having required the slightest repairs. On one occasion she was between two heavy ships in a tier when it broke from its moorings, and the whole of the vessels swung across the river. She was exposed without thwarts to the whole of the pressure consequent on such an accident, but was not in the slightest degree injured.
1837	Sirius	11	$249\frac{26}{94}$	70	175 0	17 1	7 10	Built for the Rhone. The engines were high pressure, with locomotive tubular boilers. Her speed was 12 miles an hour, and she drew, when light, 2ft. 6in. She was very stable, and made the passage to Marseilles partly under canvass. She was out in a very heavy gale in the Bay of Biscay, and behaved well, and on her arrival at Marseilles, was as dry as when she left the river Thames, not having made the least water, or having sprung in the least degree.
1838	Ladoga	12	$215\frac{53}{94}$	80	140 0	18 0	9 0	Swift and strong boat, used as a messenger packet by the Russian Government. Draught of water 3ft. 8in.
1838	Nevka	13	$231\frac{34}{94}$	70	150 3	18 0	9 6	Private yacht for the imperial family of Russia. Fast, strong, and substantial, and fitted with very handsome and massive cabin furnishings, schooner-rigged, and remarkably fast under canvass. She proved herself a good sea boat on her passage across the North Sea, where she encountered some severe gales, drawing 3ft. 10in. of water. For particulars see Weale's Appendix to Tredgold, parts A and B, where all the details are published.
1838	Prussian Eagle	14	$100\frac{41}{94}$	50	118 6	14 0	6 6	Built for the Upper Elbe, for the Royal Maritime Society of Berlin, with a draught of water of 28 inches. In her passage across the North Sea, she was caught in the gales of this year, and after having been out for three days she was pooped, and was ultimately lost off the coast of Ameland, having a fishing-smack in company.
1839	Concordia	15	$118\frac{43}{94}$	26	112 3	15 0	8 3	Built for the Upper Rhine, and sent out in sections. She has proved a fast and good boat; draught of water 3ft. 6in.
1839 and 1840	Two steamers	16 17	334	80	125 0	24 0	9 0	Built for the Hon. East India Company for Bombay, and sent out in sections.
	Four steamers	18 to 21	334	80	125 0	24 0	9 0 and 5 0	Built for the Hon. East India Company, and sent in sections to Calcutta.
	Four accommodation boats.	22 to 25	334	—	125 0	24 0	5 0	Built for the Hon. East India Company, and sent as above.
1839	The Shell	26	$111\frac{71}{94}$	30	102 6	15 3	4 0	Steam barge for the Thames up to Oxford, passing through the locks. She has two paddle-wheels on the quarters, and goes fast with a cargo of 50 tons on a draught of 3ft. 3in.
1839	Woronzow Pradpriatie	27 } 28 }	$91\frac{2}{94}$	40	81 0	16 0	8 0	Built for the "Russian Government" for the Black Sea, for the purpose of towing lighters at the mouth of the rivers, and confined in draught of water to 3ft. 4in. They proved themselves on the passage out to be perfectly safe as sea boats, though unable to beat to windward, and in the Black Sea, they encountered the very severe gales of November and December of this year. One of them was on shore, but was lightened, and afterwards got off uninjured and proceeded, and on arriving at Sevastopol got up steam, and towed a large Russian steamer into the harbour.

Date.	Name.	No.	Tonnage.	Horse Power.	Length on Deck.	Beam.	Depth of Hold.	Remarks.
					ft. in.	ft. in.	ft. in.	
1839	Dolphin	29	$106\frac{59}{94}$	50	111 6	14 0	7 6	Built for the "Royal Maritime Society" of Berlin for the Upper Elbe, Havel and Spree to Berlin. The dimensions were regulated by some locks and bridges. She is of a very full model to save draught of water, which was limited to 2ft. 2in. She is partly used as a tug boat for towing the lighters of the country.
1840	Coquette	30	$163\frac{34}{94}$	50	150 0	15 0	8 0	Fast and strong built. She is very stable, and her speed is fully equal to 13 miles an hour. Her great length gives great accommodation for tonnage, and if speed and accommodation are considered conjointly, the results are perhaps the best yet obtained by any vessel.
1840	Iron Duke	31	$109\frac{73}{94}$	24	104 6	15 0	7 9	For the river at Demerara, as a steam-barge to carry 40 hogsheads of sugar, stowed in the holds, on a draught of 3ft. 3in. She carried this cargo at a speed of 7 miles an hour, and made the passage across the Atlantic in safety on this draught of water, being fitted with lee-boards like the Yorkshire billy buoys.
1840	Telegraph	32	$206\frac{45}{94}$	45	136 0	18 0	8 3	Built for the Weser and adjoining coasts, and gives good results, being a strong and substantial boat. The draught of water was confined to 2ft. 8in. She made the passage from Gravesend to Bremenhafen in 46 hours.
1840	Steamer	33	$38\frac{65}{94}$	14	81 0	10 0	7 6 and 4 6	Built for one of the lakes in the north of Italy, and sent out in sections.
1840	Rose Thistle	34 } 36 }	$305\frac{54}{94}$	100	153 6	20 6	11 6	Built for Sydney in every respect as sea-going steamers of the first class. They are built of a very fine model and are very fast. Their speed in the river when light was proved to be 13 miles an hour. They carry 60 tons of cargo on a draught of 7 feet of water.
1840	Steam dredge	35	54	6	65 0	14 0	4 0	Built for clearing out the Fossdyke Navigation with bucket frames to work on either side, and deepen the sides of the canal. The draught of water is 2ft. 3in., and she was towed round the coast of Lincolnshire, by a steamer without injury in the month of January.
1840	Steam ferry boat	37	$25\frac{59}{94}$	12	66 6	9 0	7 0 and 4 6	Built for Calcutta for the Hoogly, and sent out in sections, with oscillating engines. The draught of water will not exceed 18 inches when light.
1840	Canal boat	38	$11\frac{74}{94}$	—	65 0	6 0	3 2	Adapted for swift canal navigation by horses, at a speed of 10 miles an hour.
1840	Steam barge	39	$31\frac{67}{94}$		78 9	9 0	5 0	Built for an experimental barge.
1841	Yarra Yarra	40	$93\frac{40}{94}$	30	96 0	14 6	7 10	Built for Port Phillip, New South Wales, and sent out in sections all complete.
1841	Juno	41	$135\frac{40}{94}$	—	82 3	19 6	12 0	Building for the trade between London and Hull. To be rigged as a schooner.
1841	Barge	42	$68\frac{38}{94}$	48 men	60 0	16 0	4 0	Building for a floating fire-engine, and fitted with a pair of paddle-wheels. The engines are worked by cranked handles by 48 men, and arrangement is made by which they can be thrown out of gear, and the paddle-wheels can be connected and set in motion, that the barge may be easily removed to wherever it may be required.
1841	Steamer	43	$254\frac{57}{94}$	80	150 3	19 0	10 0	Building for the Royal Danish Board of Admiralty, and intended chiefly for a private yacht for the Royal family of Denmark.

The extensive use of iron steam vessels makes any information upon the subject most valuable, and we therefore feel highly indebted to Messrs. Fairbairn for their liberality in furnishing us with the preceding notes. Being engaged in this manufacture to such an extent, the results of Messrs. Fairbairn's experience are valuable, and we trust that their example will enable us to obtain from other distinguished engineers such materials as will form an important record of the progress of this branch of engineering and marine architecture.

THE BOARD OF TRADE AND THE RAILWAYS BILL.

During the last month a good deal of time has been lost with the Easter recess, so that the committee to whom at Sir Robert Peel's wish was referred the consideration of the powers as to railways to be given to the Board of Trade was only able to meet in the beginning of the month, when for several days they were employed in hearing witnesses for and against the plans of the Board of Trade. The evidence of Mr. Brunel against the proposed interference is said to have had great influence upon the committee, and seriously to have annoyed Mr. Labouchere, but we regret to have heard it reported that a railway engineer of great eminence had taken a very different course, and had given his support in favour of the views of the Board of Trade, and against the profession. We sincerely hope that there may have been some mis-statement with regard to this latter circumstance, as we think that such a course at the present moment is likely to be of serious prejudice to the welfare of the profession. On the motion of Lord Granville Somerset a number of reports and returns relative to railways have been published, which are quite confirmatory of the worst surmises as to the conduct and intention of the Board, and its Commissioners. It is very true that much of the arrogance of the government functionaries is directed against the companies and directors, but it must not be supposed that they are the only parties threatened. On the contrary, the military engineers (for such we regret to say all the inspectors have been) give arbitrary opinions as to the use of blocks or chairs, the form and weight of rails and chairs, the construction of locomotives and carriages, the manufacture of axles and wheels, gradients, embankments, mode of working, and whatever else they can possibly interfere with. Nor is this all, for one of the party, with the accustomed hankering for meddling with private property, proposes to excise the locomotive engineers, as Major Pringle and his colleague did the marine engineers. It is suggested that to ensure the manufacture of axles of proper materials, the engineers and the assistants should at all times have access to every part of the works, and it needs scarcely to be presumed that this suggestion will be carried by the same power being claimed for the government officers, powers which it is known are useless as a protection, and useful only as an annoyance, for if there be a disposition to act wrongly no inspection of this kind avails, instances having occurred of fraudulent rails having been made under the very eyes of engineers. In the same spirit recommendations were made that stations should be shut up, and that locomotive engines should be licensed, a recommendation, which though to short-sighted men it may appear to the advantage of engineers is clearly the reverse, for it is sure to follow that under such restrictions the supply must be reduced.

The bill itself we have described, this appendix to it is a rich commentary on its spirit, dictated by ignorance, it is pregnant with quackery and oppression, and while its recommendations would be inoperative for any useful purpose, they would be abundantly effective for mischief, a delusion on the public and an injury to the profession. In the course of the last month all the railway companies have petitioned against it, not one engineer. We have done our duty, we have called —we call on the profession to petition and oppose, and we urge them to lose no time. Let them read Colonel Thomson's report, and imagine such a man as he excising their offices and their workshops, and then if they are not aroused, we do not imagine they ever will be.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXVI.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. It is consolatory to learn from the Licensers' *imprimatur*, that the "Fabbriche e Disegni di Andrea Palladio" do not contain any thing contrary to *la Santa Fede Cattolica!*—they might as well have assured us that Palladio was not the heathen divinity Pallas. Yet if the collection contain nothing against the holy Catholic faith, it contains much that is calculated to stagger any reasonable man's faith in criticism, and to shock his taste mortally, if he has any taste to be shocked at all. The very best of Palladio's designs are but very mediocre indeed, and some of them absolutely barbarous. His "Palace of Reason"—as Mrs. Cresy somewhat unreasonably calls it—is just execrable; his Teatro Olimpico, just damnable. And should it be said that this is mere sweeping condemnation, amounting to nothing, I reply that it is quite as good criticism as that in which the admirers of their incomparable Andrea deal in. The *onus probandi* lies with them; and if they are utterly unable to point out any of those beauties, graces, and excellences which they place so largely to the credit of their favourite, they have centainly no right to censure their opponents for being not more explicit. Should it further be thought by some of my readers that I am continually "harping upon" Palladio, my excuse is that I feel it necessary to do so, as long as others continue to babble their praises of him. When they choose to desist from their tedious iterations, I may give over mine; but I do not see why I should fling up the game, while they continue it.

II. Though few will give me credit for blushing at any time, I frequently do blush at the drivelling silliness one meets with in architectural writers—the more than anile twaddling to which they are addicted, for even the most twaddling old woman would hardly utter such stuff, unless, she happened to be disguised—in liquour.—"Facendosi addietro di sicolo in secolo," says one, "tracing back the art from age to age, we discover it to be almost contemporaneous with the origin of the human race." Wonderful discovery, truly! But still the tailors have in point of antiquity, superiority over architects, for Breeches-making is indisputably the oldest art upon record. Surely those who write such egregious balderdash must trust largely to the stultification of their readers. Writers on the art culinary are by far a more sensible race, abstaining from such asinine absurdities in which architectural ones are apt to indulge, and for which they ought to be made to bear a fool's cap as their crest.

III. It certainly is amusing enough to observe how excessively lax and licentious are some of those grave twaddling architectural puritans who lay so much stress upon proportions, as if they were absolutely articles of faith. People of that sort are absolutely scandalized at the idea of any alteration in the shape of a base or capital, or of making an entablature at all deeper or the contrary than usual; yet they are not the least shocked at seeing an entire ordinance thrown out of proportion by disproportionably wide intercolumns; nor have they any notion of regulating the entablature according to the distance between column and column, notwithstanding that it is obvious that if those intervals be unusually wide the entablature ought to be of lighter proportions than is else given to the order; and *vice versa*. For this reason, if for no other, the portico of the National Gallery ought to have had a bolder and richer cornice, the intercolumniation being pycnostyle, and consequently the supports numerous and the openings between them narrow. For the same reason, the pediment might very properly have been made deeper. Unfortunately, however, Wilkins was one of those people, who suffer themselves to be duped—or rather, who dupe themselves by words and names. His building was to be *Greek*—that was with him a *sine qua non*, to which other considerations were to give way. A Roman entablature or cornice was out of the question, not because it would not have harmonized with the columns, but because it might have been *called* Roman, and there might have been a sort of discord, not visible indeed, but *nominal*—of course a most offensive one, for it is well known that people in general judge of architecture as they do of pictures and of wines. Tell them that a picture is by Raphael or Corregio, and though it be ever so mediocre, they fall into raptures with it, at that word of command. Call gooseberry wine by its proper name, and people turn up their noses at it, yet dignify it by the style of champagne, and it becomes delicious. Under the sanction of Inigo Jones or any other celebrated body's name, the dullest design imaginable passes for a very fine thing, where one a thousand times better by some nobody, would hardly be looked at.—I was once equally amused and enlightened at the expense of an unfortunate critic who was a professed admirer—I might say venerator of Palladio. We were turning over a portfolio of loose architectural prints and drawings, among which there happened to be one or two to which I called his attention more particularly, at the same time instancing several egregious sins in them against good taste. After assenting to all my objections, he exclaimed "they are indeed very trumpery specimens of the Italian style: they have nothing of the *sana architettura*—of the gracefulness and happy *non so che* of the divine Palladio."—"The deuce they haven't!—why is it possible that you do not recognize them as the production of your divine Palladio himself?"—He looked—what shall I say, aghast?—no he looked as if he was actually going to jump down his own throat." The next time I saw him I said—"and the divine Palladio ——," on which he cut me short by crying out, with no lack of emphasis—"Palladio be damned!"

IV. For graphic power—for consummate mastery in the art of depicting to the eye by means of the pen alone the loveliest scenery, and conjuring up the most enchanting prospects—the most fascinating visions,—I hold George Robins to be the greatest genius this or any country has ever produced. Some of his advertisements are perfect cabinet pictures, finished up with unrivalled delicacy and grace, and replete with such felicity of imagination that every object—no matter what it may be in itself, is transmuted into beauty by the potent alchemy of his pen. As viewed through the medium of his poetic imagination, a snug suburban tenement with an acre of domain attached to it, becomes—I will not say "un pezzo di cielo," nor an absolute paradise, nor a *lot* from the Elysian Fields,—but certainly a fragment of Arcadia, a pastoral landscape fit for a scene in an opera—a fairy-land encompassed by the hedge that fences it out from ordinary, every-day nature—from the mere fields, the green grass and green trees, that may be seen anywhere else. From my soul I pity the dull creatures who can see nothing more in the great G. R.'s effusions than a mere auctioneer's advertisement; and I also pity those who toss from them the half sheet of the Times, exclaiming in a tone of disappointment, it is nothing but advertisements, when advertisements are in fact the very essence of a newspaper, and the rest but mere flummery and filling-up stuff, a farrago of twaddle political, fashionable, &c., dressed up in blustering phrases.

V. "I have seen Abbotsford," says T. H. C., the clever author of "A Descriptive Tour in Scotland,"—"and I hardly know whether I do not regret that I have done so. It is not the Abbotsford of my imagination, nor of the author's description. Where is the 'romance in lime and stone'?—Dwindled to a mere story. In the exterior of the dwelling there is no congruity, no massive nobleness. In the interior there is no space for ghosts to play at hide-and-seek. If there be a few odd holes and corners, they appear rather like small remnants of a scanty cloth that has been cut into a thrifty garment, than the 'ample room and verge enough' of true antiquity. Nothing is on a great scale. Ichabod—the glory is departed. In this as in other instances, *exaggerating describers have much to answer for*."—Mark you that, my dear George Robins!—"At their hands one demands an account of one's demolished hopes and scattered visions." If so, a good many dealers in description will have an awfully long and heavy score to settle with their readers. The best way for them to do so, would be to bring in a *per contra* account for so many manufactured visions of grandeur and beauty—not a trace of which is to be discovered in the objects themselves.

VI. A most outrageous sort of delicacy is affected by writers upon architecture who generally evade speaking of contemporary buildings, under the pretence of its being invidious to make any comments on the works of living architects. Such excuse is most flimsy: or if there be any thing in it at all, gross indeed must be the indelicacy of literary critics and reviewers who make the publications and writers of the day the subject of their comments, without the slightest sort of scruple or ceremony, and frequently with the greatest imaginable freedom. The excuse itself moreover, is not particularly complimentary to the living, inasmuch as it almost amounts to the declaration that silence on the part of criticism can alone save them and their works from the censures that honestly expressed opinion would inflict upon them. In itself, however, such silence is, I have no doubt, exceedingly convenient, for I suspect that those who avail themselves of it, have seldom any opinion of their own to express, but generally serve up to their readers second-hand *criticism*, got out of books.

A NEW SIGNAL LIGHT FOR RAILWAYS.

By Alan Stevenson, LL.B., Civil Engineer, Edinburgh.

(Read before the Society of Arts for Scotland, 22nd February, 1841.)

The numerous accidents, attended with fatal consequences, which have lately occurred on railways, have excited much alarm in the public mind, and the prevention of these casualties is unquestionably a matter of great importance. The object of this communication is, to point out one source of danger to which several of the late accidents may be attributed, and to suggest the means of its removal: and from the personal interest which all must have in the improvement of railway travelling, both as regards its speed, and, what is of much greater importance, its safety, I venture to hope that the following observations, although limited to one part of the subject, will not be found to have been unsuitably addressed to a society whose province it is to improve the useful arts.

One of the most imperfect parts of the railway system is undoubtedly the uncertainty of the night signals, and to this it is well known many of the most fatal of the accidents which have occurred must be traced. The great object of these signal lights is, to announce that the train has reached a certain point of its course, and to forewarn the engineman of his approach to a station, or the junction of a branch railway, so that the speed of the engine may be checked in proper time to prevent collision. The lights used for this purpose are generally exhibited at the place the approach to which they are intended to announce: but the distance at which light projected horizontally, may be seen by a person approaching in the line of its transmission is very variable according to the state of the atmosphere, which in our climate is subject to great and sudden changes, in regard to clearness and fog. These variations in the visibility of lights of extensive range are by no means confined within narrow limits, as experience too amply demonstrates in the case of lighthouses, whose range has been known to vary with the state of the atmosphere, from sixty miles down to two or three miles; and this evil is unhappily one of those which, in the present state of chemical and optical science, must, we fear, be pronounced irremediable. This defect, great as it is in regard to lighthouses, is, in the case of railways, materially aggravated by the excessive velocity of railway travelling. Any variation in the distance at which a signal light is first seen, must lead to great misconceptions as to the time of reaching a station, and all such misconceptions are fraught with the worst consequences, owing to the numerous sources of danger from the crossings of branch lines, the meeting of carriages on the rails, or the occurrence of other accidents, which may render a railway impassable. It is therefore obviously indispensable to safety that the signal-lights should be so constructed, that in all states of the weather they shall be constantly visible at the same point, and that this point shall be sufficiently distant from the station, the approach to which the signal is intended to announce, so as to allow ample time for checking the engine's speed before coming up to it; and upon no other grounds can the confidence of the public as to their security be reasonably based.

In the month of December last, it occurred to me in the course of conversation with my friend Mr. Errington, civil engineer, that although the variation in the visibility of lights of distant range must, according to our present knowledge, be regarded as an evil without remedy, it might still be possible, by means of some arrangement of the lights, to render *signals for railways constantly visible at the same point during every state of the atmosphere.* For this purpose, all that seems to be necessary is, to *limit* the range of the lights, and at the same time to increase their intensity in such a manner that the combination of a short range with great power may not merely render them capable of penetrating any fog however dense, but of producing, at a certain point, an effect so brilliant and striking as forcibly to arrest the engineman's attention. After considering the matter in various points of view, I came to the conclusion that the object could be best attained by placing the light considerably *in advance* of the station, the approach to which it is intended to announce, and by giving the beam such an inclination to the horizon, that its greatest power may fall upon the engineman's face, at so short a distance from the light itself, that it could not fail to be always visible at that point, even in the thickest fog.

According to the present practice, a comparatively feeble light is exhibited at the station whose position it is intended to point out, and this light, which is permitted to pierce the gloom until its power is greatly diluted by the united effects of its own divergence, and the length of its passage through a foggy medium, must necessarily be subject to constant variation of visibility with every change of the atmosphere. The change which I have to suggest, is to place a light of great power about a mile in advance of the station, and at the same time to limit its range by the depression of the resultant beam within such a distance as to ensure its being visible at all times.

The arrangement I would propose for the attainment of this object is remarkably simple, and consists in placing one of Fresnel's annular lenses, illuminated by a gas or oil burner, as may be most convenient, in a small chamber, glazed in front, and supported on a stage of carpentry of sufficient size to span the rails, and permit the train to pass under it; but the purpose might perhaps be equally well served by placing the stage at the side of the railway, and inclining the beam obliquely to the line. In order to limit the range of the lens to a short distance, and thereby to ensure the light being visible in all states of the weather at the same point, I would incline the instrument, so that the length of the trajectory from the lens to the observer's eye should not exceed about 700 feet, which falls far short of the distance at which the light of the lens would be obscured even in the thickest fog. I may remark that the inclination of the lens is too small to require any correction in the position of the flame; but this could be easily accomplished if necessary, more especially when gas is employed. In curved lines of railway the same effect might in certain cases be produced by placing the lens on a level with the observer's eye, and directing the refracted beam so as to cut the railway obliquely. In this case the limitation of range would be produced without the necessity of inclining the lens: but the principle of rendering the signal at all times effective, by combining a short range and a powerful light, is the same in both arrangements.

The advantage of this arrangement I conceive to be great, for not only would the light be at all times visible to the engineman on his arrival at the same point which, as already mentioned, is really the great object of signal lights; but it is obvious that his attention would be most effectually awakened by the contrast of suddenly passing from darkness to receive the full effect of a powerful light viewed from a short distance. One other advantage of the proposed signal light, I must observe, lies in its being peculiarly susceptible of any modification of colour, whether of a temporary or permanent kind, which the numerous and growing wants of an extended railway system may require. The alphabet of nocturnal telegraphy, wherever a distant range is required, is unhappily extremely scanty; for the practice of all Europe seems to have shown that, so far as colour is concerned, *red* and *white* are its *alpha* and *omega*; green and blue have been frequently tried; but cautious inquirers have all agreed in pronouncing them so equivocal when viewed from a distance, that they have been almost universally abandoned. These colours, however, and even much less marked varieties, although useless as distinctions for lights of distant range, are perfectly effective when viewed from short distances, as the brilliant display of an apothecary's window sufficiently proves.

I shall now add a very few words regarding what appears to me to be the chief arrangements which may, in practice, be found necessary for signal-lights on these principles: but I would not be understood as attempting to fix any thing permanently, for I am well aware that various modifications may be suggested by experiment, which I do not at present foresee in their full extent: in particular, it seems probable that the range of visibility which I have adopted in the following view of the details, falls short of what will be found quite sufficient in practice even during the thickest fogs, when a light so powerful as that which may be derived from Fresnel's lens is brought into play; and should this expectation be realized, the duration of the effect of the light, which depends on the range, might be increased beyond what I have ventured to state.

Referring to the above sketch, I would propose that the lens at L should be elevated 24 feet above the rails R R, or about 15 feet above as is consistent with a full effect from a flame placed in its principal focus. A more remote observer would receive the rays diluted by distance; while a nearer approach of the eye to the lens would render it necessary to adopt an ex-focal arrangement, so as to cause convergence of the rays. By the latter arrangement their divergence would be decreased, and the space covered by the light would be lessened not only in proportion to the decrease of divergence, but also to that of the cosine of the beam's inclination to the horizon. Both these circumstances would therefore combine to curtail the duration of the impression on the eye.

It may naturally be expected that I should say something regarding the duration of the impulse of the light on the eye; and upon this topic I shall, in absence of actual experiment, content myself with stating briefly the result of my calculations. If we suppose that an effective divergence of only 2° were to be obtained (and this is just one third of what is obtained from Fresnel's lens with the great lamp), I find that the light would spread itself along the horizon of the observer's eye between B and C to the distance of about 1000 yards, which, at the speed of 40 miles an hour, would be passed over in about 50 seconds, but at the ordinary railway speed of 25 miles an hour, about 80 seconds or 1⅓ minute, would be required. Such a flash of light falling upon the polished parts of the engine, and upon the observer's face, would undoubtedly act as a most effective signal. If, however, it should be thought advisable to increase the duration of the impression by spreading it over a greater length of the line, this effect could be easily produced by a slight alteration of the inclination of the lens, so as to cause the line of railway to cut the refracted beam more obliquely; but I by no means expect that any such modification would be found necessary in practice. The nearness of the eye to the lens, and the brilliancy of the flash, would, I am inclined to think, more than compensate for the shortness of the impression.

I must add a few words regarding the expense of these signals, which would be made up of the cost of erecting the scaffold of carpentry, the price of the lens, and the maintenance of the light. The price of the stage I shall pass over as a matter which may vary according to the circumstances of the situation and the taste of individuals; but the cost of the great annular lens does not exceed 40*l*.; and if a smaller sized lens, which I think would be found quite sufficient for the purpose, were employed, the expense would not be more than 10*l*. The annual maintenance would consist of little more than the supply of a gas or an oil burner. The consideration of the expense, therefore, of maintaining such a system of signals at the necessary intervals on railways, is not for a moment to be set against the most remote risk of the least of all the numerous accidents, the records of which fill the public prints.

OBSERVATIONS ON THE MOTIONS OF SHINGLE BEACHES.

By Henry R. Palmer, Esq., F.R.S.*

From the Philosophical Transactions of the Royal Society:—read April 10, 1834.

The extraordinary prevalence of tempestuous weather during the last autumn having occasioned numerous disasters on our coast, the public attention was directed in an unusual degree to the imperfections of many of the harbours, and more particularly to those which are encumbered with accumulations of shingle. The access to harbours thus circumstanced is generally uncertain, and in tempestuous weather is frequently dangerous, or even impossible.

The action of the sea, which gives motion to the shingles and produces the evils complained of, has long been a subject of speculation; but I have not found that it has been systematically investigated. Indeed, the contrariety of opinions advanced upon the subject, sufficiently indicates an entire absence of that satisfactory mode of inquiry which is essential to the foundation of a safe and practical deduction.

Very little has been written upon the subject; and such facts as have been mentioned have only been referred to incidentally, or with a view to geological science. My present object is exclusively practical in its nature, and my observations have been limited to such facts as would assist in establishing certain and fixed rules for controlling the motions of the beach, so far as to enable us to preserve a clear channel through it in all seasons, and in every variety of weather; and to accumulate and preserve the shingles, where it is needful to do so.

The subject at first sight appears greatly complicated; and were it adheres; and therefore the following observations must be considered as restricted only to certain general principles, subject to a variety of modifications.

The principles which I propose to illustrate will (under similar circumstances) at all times exhibit the same phenomena, but for the sake of perspicuity I shall now only refer to the coasts of Kent and Sussex.

Section 1.

That the pebbles which compose the shingle beaches on these coasts are kept in continual motion by the action of the sea, and that their ultimate progress is in an easterly direction, are facts long known and commonly observed. The following observations are chiefly directed to the particular manner in which the motions are produced.

From a general view of the effects that I have noticed, it appears that the actions of the sea upon the loose pebbles are of three kinds: the first heaps up, or accumulates the pebbles against the shore; the second disturbs, or breaks down the accumulations previously made; and the third removes, or carries forward the pebbles in a horizontal direction.

For convenience I propose to distinguish these by the following terms, viz. the first, the accumulative action; the second, the destructive action; the third, the progressive action.

All the consequences resulting from these various actions are exclusively referable to two causes. The one is to the current, or the motion of the general body of the water in the ebbing and flowing of the tides; the other to the waves, or that undulating motion given to the water by the action of the winds upon it; and it is of considerable importance to the present inquiry that the effects resulting from each specific cause be separately considered.

The motion of the shingles along the shore is commonly attributed to the currents, the action of the waves being considered only as a disturbing force. That such a notion is erroneous will, I apprehend, presently appear; although I have to regret that I have not had the opportunity of obtaining such satisfactory information relating to the velocities of the currents in the channel, as would have enabled me to include every form of argument upon the subject. The absence of such information has also prevented me from deciding satisfactorily as to the sources from whence the whole body of shingle is derived, which, although not necessary for the practical purposes I have in view, would have given more interest to the subject, and would have rendered the elucidation more complete. I must, therefore, for the present, be content to pursue the motions of the beach after it is found lying along or near the shore; observing only that the materials of which it is composed are those of the various strata in the vicinity of the coasts, together with the ordinary sea sand, and such small particles as may have been brought to the shore by the floods of the various rivers.

That the current is not the force which moves the pebbles along the coast, will appear from the following reasons:

1st. If it were so, the direction of the motion of the pebbles would be determined by that of the currents; but while the direction of the currents will vary with the changes of the tides, we find that the direction of the pebbles may remain unaltered; and also that the motion of the pebbles is continued where no current exists.

2nd. Although the velocities of the currents may not have been ascertained with precision, yet it is known that the velocities generally along this coast, which can possibly act on the shingles, are not sufficient to give motion to pebbles of every dimension, which are in fact carried forward.

3rd. The motion of a current will not produce that order in which the pebbles are found to lie, which order (as will be hereafter shown) may easily be distinguished as the effect of the motion of the waves only.

The direction of the waves is determined principally by the wind, the prevailing direction of which on the coasts referred to is from the westward. Every breaker is seen to drive before it the loose materials which it meets; these are thrown up the inclined plane on which they rest, and in a direction corresponding generally with that of the breaker. In all cases we observe that the finer particles descend the whole distance with the returning breaker, unless accidentally deposited in some interstices; but we perceive that the larger pebbles return only a part of the distance; and upon further inspection we find that the distance to which each pebble returns bears some relation to its dimensions. This process is an indication of the accumulative action.

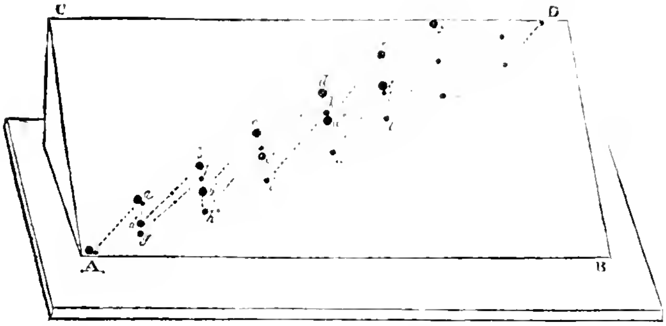
But under some circumstances, depending on the wind, it is found the level of the engineman's eyes; and that the point where the centre of the beam would intersect the horizon, A C, of his vision at E, should be about 700 feet from the lens. The impulse of the light would be most advantageously received at some point as near the lens

* The construction of harbours, piers, and breakwaters is likely to become of considerable importance to the engineering profession; we therefore propose to collect for publication in the Journal, such papers as have been written on the subject.

necessary to discuss minutely all the modifications arising from the variety of forms and local circumstances, it would perhaps be too much so for general description. I have, however, limited my investigation to those simple and unvarying laws to which nature always that pebbles of every dimension return with the breakers that forced them up the plane, and that these are accompanied also by others, which had been previously deposited, but which are in such cases disturbed by the waves; and by a continued repetition of the breakers acting in this manner, the whole of the shingle previously accumulated is immersed below the surface of the water. This process is an indication of the destructive action.

The particulars of the accumulative action, *combined with that of progression*, are explained as follows. (Fig. 1.)

Fig. 1.



Let ABCD be an inclined plane, representing that on which the loose pebbles move. Suppose the wind to blow in such a direction as to cause a wave to strike a pebble at A, in the direction of A *a*, and to the distance (*a*) up the plane, that point being the extent to which the force can reach. Now here the wave breaks partly into spray, and is dispersed in all directions: is partly absorbed, and descends in a shallow form, which rapidly diminishes in its depth, so that the pebble is soon left exposed, and therefore does not return the whole distance with the water, but is left at rest at (*a'*), being at a higher level than that from whence its motion commenced.

With the rise of the tide the striking force is also elevated; and by the repetition of the operation described through the different heights in succession, the further motion of the pebble will be represented by *a' b' b' b'*, &c., the distance in each step of its descent being something less than in that of its ascent, until it has reached the summit (*f*) determined by the height of the tide. Now if we suppose a pebble of less dimensions than the former to be struck from the same point, we shall find it raised as before; but because its surface is greater in proportion to its weight, and because from its less bulk it remains longer immersed in the declining wave, it will descend further, and follow the line (*a g*, &c.), and will not be left at rest till it has reached (*o*).

If, then, we suppose a pebble whose dimensions are less than either of the former, it will be evident that the point at which that will arrive on the highest level will be more distant still: hence it follows that the distance travelled horizontally by the pebbles during a tide will be in some proportion to their bulk, the specific gravities being the same.

(The pebbles do not in reality move in straight lines, but in a succession of curves; the straight lines are assumed here, and in other parts of this paper, to simplify the description.)

I trust it is only necessary to remark, that if the wind continue to blow in the same direction during the ebbing of the tide as through the flowing of it, the direction in which the waves will strike the shore will be nearly the same, and the progress of the pebbles will be urged by a similar action, and therefore their direction will also be the same.

In this action we observe a constant tendency to heap up and accumulate the shingles; and it is an interesting fact, that when the action has continued equally through a tide, the pebbles are left *in regular order, according to their dimensions*, the largest being uppermost, and the smallest at the bottom of the plane. I do not mean to state that all the largest are at the top, or that all the smallest are at the bottom, for it is evident that some of every size will be found at every level; but that if an equal measure (say half a peck) be taken from the different levels, the average of each specimen will exhibit in regular order the various dimensions.

The order in which the pebbles are thus found is, then, that by which the effect of the waves is distinguished from that of a current, the effect of the latter consisting only in its influence on the direction of the impinging and recoiling motions of the waves, by which the motion of the beach may in a small degree be accelerated or retarded.

Section 2.

In the illustration of that action of the sea which breaks down and removes an accumulation, I propose referring to my observations in the order in which they were made. My attention was first directed to this part of the subject in the neighbourhood of Sandgate in October last.

The accumulative action had been continued for a considerable time. The numerous groins erected near Folkstone to impede the progress of the beach, for the protection of the cliffs, had collected a bank of pebbles, which in some parts was five feet in height. The wind had so much abated as to be scarcely perceptible, but the sea had a motion denominated a *ground swell.*

The waves approached the shore nearly at right angles with it; but although in rapid succession, their forces were very moderate. These circumstances continued through five tides, by which time nearly the whole of the loose shingle had disappeared, including all that had been collected by the groins at Folkstone. The water being particularly clear, I was enabled to perceive distinctly the action upon the pebbles, and their motion downwards. I observed, that although every wave became broken and dispersed as usual, yet they followed in such rapid succession, that each wave rode over its predecessor while on its return, and thus produced a continual downward current, which carried with it the pebbles that were disturbed. That the pebbles were not removed far from the line of low water, would appear from the fact, that on the subsiding of the swell, it being succeeded by a light breeze of wind from the westward, the accumulation immediately commenced, and was restored to its former quantity by the action of four tides. I have subsequently had some favourable opportunities for making other observations on the effects produced by different rates of succession of the waves, and particularly at Dover, during the late gales, where the same actions were noticed. There I watched for an opportunity of witnessing that rate of succession which exhibited the destructive and accumulative actions in their smallest degrees; and I observed, that when ten breakers arrived in one minute, the destructive action was but just evinced: and that when only eight breakers arrived in the same period, the pebbles began to accumulate; which facts harmonized with my observations made at Sandgate and Folkstone, viz. *that the difference between the two actions was determined by the rapidity in succession of the waves upon the shores.*

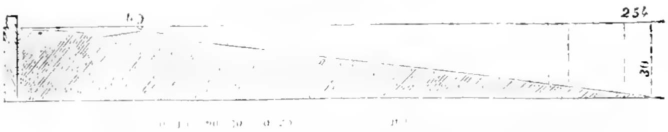
In the description of the accumulative action, I have assumed the forces to be directed obliquely with the line of coast, and have therefore necessarily included the progressive motion: but it remains to be explained in what manner the shingles are carried forward while the destructive action is going on.

It is known that the action and re-action of the waves give to the whole body of the water, within a certain distance from the shore, an undulating motion. The direction of this motion, when approaching the shore, will, to a certain degree, correspond with that of the waves upon the surface, and the direction of the recoil will also be affected in like manner; therefore the pebbles that have been carried down by the destructive action are moved forward through an angular course *beneath the water*, until, by the excess of the impinging forces over those of the recoil, they are again raised by the action of the water, and deposited where the destructive action has ceased, or where, from local circumstances, it cannot occur. The circumstances which are most unfavourable to the destructive action are those which least admit of the constant downward under-current,—an inlet, or narrow arm of the sea, for example. If we suppose a wave rolling through the mouth of an inlet, carrying with it a charge of shingles, it does not break as upon an inclined plane, but is dispersed in the general body of the water, which is comparatively quiescent; and there being no returning force, the shingle becomes deposited, and a bank is formed: and although the destructive process would act upon that bank if it could attain a certain height, yet the attainment of that height is prevented by the waves passing over it, and carrying with them, in succession, the shingles with which they are charged.

Section 3.

In fig. 2 is represented a section of the beach formed along the outside of Folkstone Harbour.' This section was taken with great accuracy, after the ground swell before referred to had removed most of the loose pebbles from it; so that the section may be considered as representing the plane upon which the progressive motion of the pebbles is carried on. Its slope is in the proportion of 1 to 9, nearly, and (with the exception of that part near the summit where there remained

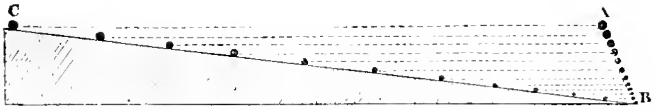
Fig. 2.



a bank of pebbles beyond the reach of the previous tides,) the surface of the plane corresponds very nearly with a straight line, which, considering that it is a natural formation, is a fact worthy of notice.

I think this plane may be considered as representing the average dimensions and inclinations of the surfaces over which the beach travels along this coast, and I have therefore generally assumed such an one for the present purposes. Upon such an inclination, the loose pebbles are in contact with each other; and although their depth upon the plane is constantly varying, yet, for the sake of conveying a general idea, we may assume the average to be about six inches, extending between high and low-water marks. When, however, the plane is less inclined, the same quantity of beach is spread over a larger surface, and its depth is diminished; and the pebbles are in some places so far separated as to exhibit the appearance of a diminished quantity. In fig. 3, this is illustrated geometrically

Fig. 3.



Let A B represent a plane on which all the pebbles are in contact, C B a plane considerably more inclined. If, from the centre of each pebble on the plane A B, a horizontal line be drawn to the plane C B, the position of the pebbles on the latter will be respectively at the various points of intersection.

Section 4.

There are numerous points on the coast at which the line of beach is apparently intercepted and its continuity destroyed, and the rock washed bare. Having sufficient evidence that the motion of the beach was continuous, I thought it important to ascertain in what manner the pebbles escaped past those places, and was happy in finding, upon investigation, that a valuable deduction could be made.

In the description of the accumulative action, it was remarked that the waves having struck the pebbles upwards, became dispersed, and were incapable of returning them to the level from which they were forced. But I now observed, that the surface of the rock, being very irregular, constituted numerous channels; so that the waves, instead of returning in a dispersed and weakened form, moved back in columns, which were of sufficient power to return every pebble that had been thrown up; and as these channels offered no impediment to the angular progressive motion of the pebbles, it was more rapid than on the ordinary plane surface. Here, then, was pointed out by nature a principle on which the shingles might be hastened forward, and their accumulation about any particular place prevented; and by simply reversing that principle, a method of accumulating or retaining the shingles, where they are wanted, is also suggested, viz. by the reduction of the descending force of the breakers.

The effect of confining the retiring breakers to a column is also exemplified in another manner, when the waves are driven directly upon the beach by a moderate wind, or such as would produce the accumulative action. A succession of waves, acting over the same lines of the beach, soon forms a slight depression, which continues increasing until it becomes a definite channel. The whole line of beach being thus acted upon, it assumes the form of a series of banks parallel with each other. The waves do not then recoil in a dispersed form, but, having broken, are again collected and returned through the channels, and remove all loose matter from them. While in this state, the beach has no progressive motion, but continues (to use a military term) "marking time," until, from the change of wind, an oblique direction is given to the motion of the waves.

Section 5.

The progressive motion of the beach may be easily traced along the coast as far as the bay called Sandwich Flats. The general character of the motion during its progress is that which is most favourable, under every circumstance, to the chances of becoming securely deposited. Every part of the coast is attempted by every variety of motion in its turn, until a place of final security is discovered.

The locality of Romney Marsh appears to have afforded the sought-for shelter, and now exhibits an extraordinary example of the accumulation, which, having been combined with sand, silt, and vegetable soil derived from other sources, has long been considered an acquisition to our surface of considerable value.

Although this tract has continued increasing to the present day, yet a great quantity of the beach travels past it, and we do not find any other accumulation of much extent between that and Sandwich Flats, beyond which there is no further trace of the shingle which we have so far followed, the pebbles to the northward of these flats being evidently those derived from the cliffs near about them.

On the approach of the shingle to the Sandwich Flats, it becomes gradually dispersed, owing to the increasing inclination of the plane, until it seems to disappear. A considerable extent of these flats has attained a height very little inferior to that of the high-water mark of spring tides; and it is so nearly horizontal, that the water does not partake of that undulating motion upon it which has before been adverted to.

On the Sandwich Flats there is a continual deposit of soil and silt, brought there from the interior of the country by the river Stour, and which, after its exposure to salt water, is particularly suitable for permanently uniting all the coarser or larger fragments with which it may become intermixed. So much of the materials which have composed the beach as may be conveyed to the higher parts of these flats are not likely to be again disturbed, because many days may intervene before another tide may reach them; and they thus become united to the surface on which they rest, and gradually contribute to its height.

The greatest motion of the pebbles being where they are exposed to the action of the greatest number of waves, we must look to the lower levels of these flats to trace the further course of the greater portion of the shingle. But even the slope of the surface of the lower levels is so very gradual, that the undulating motion of the water is proportionally diminished; *the action of the water then becomes greatest in the direction of the land.* While, then, we bear in mind the nature of the soil over which it acts, we find an almost insurmountable impediment to the further progress of the shingle, and are enabled to account for the rapid extension of the Sandwich Flats towards the sea, which, in fact, is only the continuation of that process which has been for ages in operation, and which has formed a large portion of those extensive marshes between the Isle of Thanet and the main land of Kent.

Section 6.

Having described those chief principles which regulate the motion of the shingles on this coast, and having traced their progress to a final destiny, I shall now proceed with some further general remarks referring to the application of the foregoing observations.

So much effect has been attributed to the motion of the tidal currents, that vast sums have been expended in attempts to divert the motion of the shingles to a distance from the general line of the shore, from whence, by the increased depth and velocity of the current, it has been expected they would be carried past a particular spot, through which a permanently open channel has been required. Such attempts have been made at various periods during upwards of two centuries at Dover, and more recently at Folkstone in the same neighbourhood. It is hardly necessary to observe, that such attempts have not been successful, and from the principles which I have laid down, their failure may be easily accounted for.

If a wall or pier be extended from the shore into the sea, it is evident that such erection will in the first instance impede and prevent the progressive motion. It is also evident, that the progressive is not necessarily combined with the accumulative action, but, on the contrary, where the former is impeded the latter is assisted. The accumulative action, therefore, continues until the angle formed by the pier and the line of the shore is occupied, and the pier being no longer an impediment to the progressive motion, that motion is again restored, and the general mass proceeds as if no impediment had existed.

The most perspicuous evidence of these results is exemplified at the harbour of Folkstone. Previously to the commencement of this exclusively artificial work, the beach travelled along the line of cliff in the ordinary way.

By extending the walls a sufficient distance into the sea, it was expected that a commodious harbour would be formed, and the shingles diverted so far into deep water, that they could not again appear above the surface until they were removed beyond the harbour's mouth.

The accumulation, however, immediately commenced, and continued as the work advanced until it became apparent that no other effect was produced upon it than a comparatively slight change of direction.

The entrance of the harbour being much encumbered with shingle, an additional pier or jetty was erected, and extended about two hundred feet further into the sea without having approached the effect intended. It is true that some advantage was derived from the extended pier, by increasing the distance between the most violent action of the breakers and the still water of the harbour. The shingles, therefore, pass the mouth in a more dispersed form than they originally did, and hence they do not so readily form a barrier, neither does its perpendicular height become so great.

Much valuable information on this part of the subject is recorded in Lyon's History of Dover, which, as it may at any time be consulted, is not repeated here. I shall only remark, that from the succession of experiments made at that place, the general result has been in a considerable acquisition of new land, which, although valuable in itself, is not the object intended to be obtained.

If, then, it be admitted that projecting piers will not prevent the encumbrance about the mouth of a harbour, situated as those referred to in the tract of the restless beach, it remains to be seen how far such works may be otherwise injurious.

While the accumulative action is going on, every abrupt projection from the coast is an impediment to the progressive motion of the beach until its angle is filled up. Such abrupt projections offer no protection against the destructive action; when, therefore, by the increase of wind, the action of the sea becomes violent, an accumulation previously caused by a projecting pier is rapidly removed, and again is rapidly deposited where it is not resisted. And there is perhaps no combination of circumstances less capable of resisting, or more favourable to the deposition of, the shingle, than is found in artificial harbours, shielded by an *abrupt* weather pier in a line of beach.

With a long continuance of violent winds from the same quarter, every accumulation of loose shingle is broken down, and is hurried forward, while it unremittingly appears to seek protection. During the recent gales every inlet within the tract of the beach was seriously encumbered with it; commenced with the heap accumulated by the very pier that was intended to prevent such an effect (where such existed), and increased by the successive arrivals of those more remote, together with that quantity commonly passing along the sloping plane, but now brought down by the destructive action and forced along with accelerated motion. * *

Many very interesting facts might be mentioned concerning the effects produced by the continued gales at various places on the coast, but I find that the description of them in sufficient detail to make them useful would extend this paper much beyond the limits assigned: I, however, trust that the reference to two of the most remarkable cases will be found sufficient to illustrate the principles attempted to be explained.

Section 7.

The only natural power by which the channels through the beach are retained, is the returning force of the water, which on this coast is generally scanty. And it is obvious, that however judiciously that force may be employed, it is but *remedial in principle*, and necessarily implies a previous evil. So long, therefore, as the cause continues to act, the remedy is prevented, and the harbour becomes inaccessible when protection is most required.

If on inspection of the great bank recently thrown up at Dover, we imagine it to be dispersed over several miles of the sloping plane, and assume the whole to be in continued and equable motion, it will immediately be inferred, that the quantity that would be passing a given spot at one time would be comparatively insignificant: and hence, since we have no reason to suppose that there will be a limit to the quantity, and since it has been shown that its motion cannot be prevented, it follows that the great objects in view must be attained, first, by securing permanently such accumulations as are necessary for the protection of land from the action of the sea, or useful by their addition to its surface; and secondly, by facilitating and inciting the progressive motion of that superfluous quantity from whence the evils complained of are derived: and therefore the uninterrupted and permanent welfare of the numerous harbours which communicate with the sea, through the extensive tract of the shingle beach, is dependent more on a *system of management along the coast*, than upon particular devices adapted exclusively to each separate case.

Engraving upon Metals.—M. Melloni has announced to the French Academy that M. Cirelli, of Naples, has been able to obtain plates upon metals by galvanoplastic methods. His discovery is to form immediately the plate completely engraved after a simple design. M. Melloni has submitted some of the plates to the inspection of the Academy. The process is not detailed, as Cirelli is preparing to secure a patent for it.

PREVENTION OF EXPLOSION IN STEAM ENGINE BOILERS.

The Gold Isis Medal was presented by the Society of Arts to Mr. Robert M'Ewen, Glasgow, for his Double Mercurial Safety-Valve for Steam Engine Boilers.

There are two evils against which it is especially necessary to provide in the construction of an apparatus for preventing explosion in boilers, viz. the possibility of the steam passage being intentionally closed, for the purpose of obtaining extraordinary pressure: and the failure of the self-action of the apparatus through the accidental derangement of its parts.

Mr. M'Ewen's apparatus consists of a pair of open tubes, the ends of which are immersed in mercury contained in cups connected with the boiler by a pipe. At the junction of this pipe with its branches for the two cups, is a three-way cock, the ports of which are so proportioned to the openings of the branch pipes, that the steam can neither be opened on, nor cut off from, both cups at the same time. The mercury tubes are proportioned in length to the greatest pressure which the boiler will bear with safety; the mercury will therefore be blown out of the acting tube into the dome at the top, whenever the pressure exceeds this limit, and will fall down through the other tube into the empty cup, while the steam blows out through a pipe at the top of the dome.* When the pressure is sufficiently reduced, the cock may be turned, and the cup which was last filled becomes the acting side of the apparatus.

On the 7th of April, a committee of the Society inspected the action of Mr. M'Ewen's mercurial valve, the apparatus having been attached to the boiler at the works of Messrs. Fairbairn and Murray of Mill Wall. The steam was opened on the mercury at a pressure of five pounds to the square inch, and as soon as it attained the pressure corresponding to the length of the tubes, viz. seven pounds, the mercury was blown, without any loss, into the dome and fell into the empty cup, while the steam blew out through the pipe at the top of the dome, and was condensed in a vessel placed to receive it for the purpose of experiment. On examination of the water in this vessel, not a particle of mercury was found in it. This result sufficiently proved the efficiency of the pipe, which is produced to some distance downwards within the dome, as represented in the section fig. 1, for the purpose of preventing the mercury from splashing out with the rush of steam.

As the action of this apparatus depends simply on a *physical* principle, viz. the opposition of the elastic force of steam to the static pressure of mercury, without the intervention of a *mechanical* obstruction of any kind, it cannot fail of acting, so soon as the pressure of steam exceeds the limit corresponding to the length of the tubes. The novelty of the invention is in the employment of a mercurial tube as a safe vent for the steam, these tubes having hitherto been used only as indicators of steam pressure, being long enough to allow the steam to attain a dangerous pressure without relieving it or giving any other notice of the fact than what may be observed by the eye.

REFERENCE TO THE FIGURES.

Figure 1 represents the whole apparatus in section. A the pipe connected with the steam boiler, B the hollow plug of a cock with a side opening at C, through which the steam passes into the area D, and pressing on the mercury causes it to rise in the tube E till its weight counterbalances the force of the steam; the tube E opens into the chamber and dome F, to which there is free access for the atmosphere through the neck G; if, therefore, the steam should at any time exceed the due pressure which is limited by the length of the tube E, it will drive all the mercury before it up this tube into the chamber F, and will escape through the neck G; in the meantime the mercury will enter the opposite tube H through the small hole I, and flow down into the other vessel J, where it will be ready again to act as a safety-valve as soon as the attendant has turned round the plug B by its handle K, thus cutting off the communication of the steam with the vessel D, and opening it into the vessel J. The construction of both sides of the apparatus being exactly alike, the tube E having an aperture at L to receive the mercury from the chamber F, this operation may be repeated as often as the escape of the steam gives notice of its being necessary. The bottom of the chamber F, though straight from L to I, is curved like a trough in the cross diameter, as shown by the curve under F, to conduct all the mercury through the hole I or L, whichever may be opposite the acting tube.

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* Mr. M'Ewen intends that an alarm-whistle be placed in this opening, and also that the apparatus serve as a gauge for indicating the variation of pressure, by means of graduated float-rods in the mercury tubes.

Fig. 2.

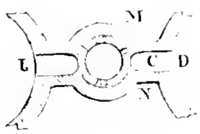
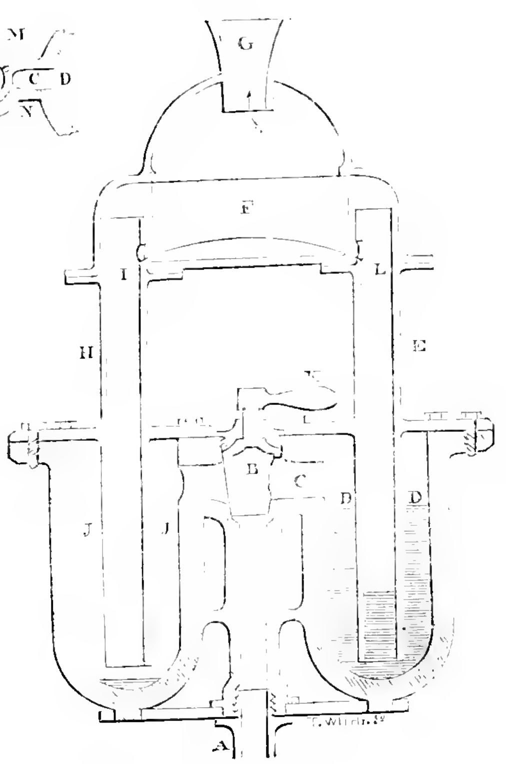


Fig. 1.



For the sake of perspicuity, only one side opening from the plug B has been adverted to. But the plug is always made with three openings, as shown in fig. 2, at C, M, and N: by which it will be seen that it is impossible to shut more than one of the chambers, D or J, at the same time. The engineer, therefore, has not the power of completely shutting off the steam by means of the cock, nor could a successful attempt be made to effect this by plugging the pipe in the dome, the material of the latter not being of sufficient strength to bear as high a pressure as the boiler.—*Trans. Soc. Arts.*

S. L. AND THE PROFESSOR OF ARCHITECTURE.

Sir.—The freedom of some of the comments in my last Fasciculus must, no doubt, have startled your correspondent S. L., and also convinced him that I fully act, *i. e.* write, up to my motto, which is very much more than can be affirmed of every one who bears a motto. It is evident he considers me as having made much *too* "free with the Professor of architecture at the Royal Academy;" just as if the Professor was a schoolmaster—some village Solomon whose sceptre is his birch, and whose subjects are bound to listen with awe to whatever he utters. What indecorum there can be in animadverting upon opinions enounced by the Professor in his public capacity, I cannot possibly conceive. Similar freedoms are taken every day with persons and personages who are quite as important—at least people fancy them so—as Professors of architecture: a truth well known to Lord Melbourne, and Lord John Russell, and to a great many others before them.

It is, I believe, generally understood that the freedom of remark which would be indelicate and reprehensible towards private individuals, is perfectly allowable towards public men, and those who hold public situations which give an influential authority to their opinions. On the last account it is, that opinions promulgated *ex cathedrâ* should be narrowly watched and scrutinized; and if they will not bear a little rough handling when examined, they are fit only to be bandboxed in lavender, and brought out, not in the lecture room, but in the drawing room.

For my part, I hold the squeamishness and affected delicacy which usually pervades architectural criticism to be not only exceedingly silly, but exceedingly mischievous into the bargain; for they tend in fact often to stifle criticism itself just at the very time when it might be applied with success; and grant impunity to some of the greatest delinquents, and to the abominations perpetrated by them, under the paltry pretence of its being a delicate and invidious task to speak of men and matters belonging immediately to our own day. This excessive caution—not to call it time-serving obsequiousness and cowardice—is almost peculiar to those who write on architecture: most certainly we find very little of it in literary criticism: where the merits of living writers, let them stand ever so high, are often discusssed with a freedom that is almost startling, or at the best very unceremonious.

However, all that I have just been saying will be thought little better than evasive remarks, under cover of which I am fain to sneak off and screen myself from the allegation made by S. L., and therefore now say in reply to it, that erroneous or not, the impression left upon myself, and a good many other persons also, I believe, was that the Professor's views were so far unfavourable to Gothic architecture as to discourage it most decidedly at the present day. To be sure he expressed a decent "for-good-manners'-sake" admiration of it, just of that sort and no more which may be professed for any other by-gone and worn-out style of the art—for Egyptian or Byzantine curiosities in it. An enthusiastic devotee in his rapturous reverence for the sublime Sir Christopher Wren,—who, by the bye, produced Temple Bar and sundry other pieces of veritable architectural bathos—the Professor is evidently ill-disposed towards the practical application or adoption of Gothic at the present day. So likewise is S. L.; and therefore both of them may probably object to the style selected for the new Houses of Parliament, and may also greatly prefer Buckingham Palace to Windsor Castle—perhaps regret that Mela Britannica's advice was not taken in regard to the latter structure; had which been done every vestige of it would have disappeared, and a low moderate-sized Grecian edifice, a mere parallelogram in plan, would have been substituted for it, as worthier to grace the acropolis of Windsor!

It would seem that mullioned windows do not accord very well with plate glass, but "are more suitable for casements with small panes of glass than for the large squares now in use." Now it may fairly be admitted that small panes do not at all disfigure Gothic windows—do not produce the same mean and palty effect they would in others: but it does not therefore exactly follow that they are indispensable to propriety of character, because, if well designed in other respects, the windows lose nothing by each compartment being filled with single plates of glass. On the contrary, the use of glass of such dimensions removes in a great measure the objection apt to be entertained against mullions of suitable proportions, as obstructing light; because, owing to the greater size and transparency of the glass, as much light is transmitted through the same space interrupted only by bold mullions, as where the mullions are very scanty, and the general surface consists of a meshwork of lead in which the glass is fixed. The chief difference between a window with small panes and one without divisions of the glass, is that in the latter case, if the entire aperture loses somewhat of the character of a glazed Gothic window, it will still resemble what is equally beautiful in the same style, namely an open screen with unglazed compartments.

But if Gothic is inapplicable because of so slight a difference as that arising from the windows being glazed with large pieces of glass instead of diminutive panes, how is it possible for us to reconcile ourselves to the infinitely greater departure from the genius of Grecian architecture, by introducing, as we most freely do, into that style, features not only unknown to, but absolutely at variance with it, not only windows, chimneys, balustrades, attics, &c.; but successive tiers of windows and windows throughout, windows within porticos, &c.? Again, small panes set in lead are to the full quite as unsuitable for windows in Grecian or Roman architecture, as they are suitable in the Gothic style, which being the case, have we not a right, according to S. L.'s notions of consistency and propriety, to be very much shocked at the semi-Gothic or Gothicly glazed windows of St. Paul's cathedral?

S. L. talks of the "difficulty of persuading persons to adopt Gothic, who are not possessed of antiquarian taste." How happens it, then that we have so many soi-disant Gothic churches and Gothic mansions which are in utter defiance of antiquarian taste or any other? why are we doomed to behold so much hole-in-the-wall Gothic—so many castellated fancies *à la Lugor?* For no other reason than because there is a bigotted and fashionable prejudice for the mere name of the style among persons who have not the slightest notion whatever of the style itself. The difficulty is not to persuade people to adopt, but to dissuade them from thinking of at all adopting a style which they will not allow to be properly treated.

Again, S. L. assures us that when modern architects design in the Gothic style, their object is imitation, but that when they employ Grecian or Roman, their aim is INVENTION!! Now no man would have ventured upon so very bold an assertion unless he had previously fortified himself and screwed up his courage to that pitch by an extra iose of claret or champagne, it being most palpable and notorious that all our Anglo-Grecian architecture betrays UTTER WANT OF INVENTION. Invention forsooth! then invention must consist in making fac-similes of Grecian columns, and poking plenty of sash windows between them: or in showing ugly chimneys, garret windows, and skylights over Grecian entablatures more faithfully than tastefully copied for the nonce, or if invention be occasionally shown, it is done after the fashion of Nash and Smirke, the former of whom has given us a Grecian Doric order in a palace, without triglyphs or even any division of frieze and architrave in its entablature, while the other has introduced doors not at all better than those of a stable or coach-house into the *classical* portico of Covent Garden theatre, *said* to be copied from that of the Parthenon, and whose columns some unlucky gin-and-water critic has lescribed as Ionic!

If S. L. can now explain away some of his own very awkward and untoward remarks, all well and good. To do so would at least display some ingenuity. All that I am afraid of is, that he will not make the attempt, but that he will henceforth be cautious of getting into a scrape by taking the part of the Professor of architecture, and leave the latter either to defend himself, or to submit to the incorrigible sauciness of

CANDIDUS.

THE ROYAL EXCHANGE.

SIR—If I am rightly informed the design for the New Royal Exchange has undergone considerable changes and modifications, especially as regards the interior court, in respect to which, if no other part, there certainly was great room for improvement, therefore as far as architectural character is concerned, I am willing to believe that improvement has been made. But why is the Exchange itself to be an open court at all? others besides myself have asked the same question—at least have animadverted upon the absurdity of making the area in which the merchants are to assemble an uncovered one, with no other shelter from the weather than what will be afforded by the ambulatories around it. The inconveniences attending such a plan are obvious enough; what countervailing advantages are expected it is difficult to guess, but it may be presumed that they are sufficiently important ones; consequently it would be but proper that they should be stated, if only in order to exonerate those who have control over the building from the charge of being guided as to so very important a point solely by obstinate caprice, and adopting what will be a serious inconvenience for no better reason at all than because it existed in the former structure—when, by the by, it was at one time contemplated to obviate it by covering in the open area. It would seem that now it is known that the building is to be erected by Mr. Tite, all interest in regard to it has entirely subsided. This ought not to be; nor ought such matters to go to sleep, and be treated as if utterly indifferent, because no one has now any thing farther to expect from any change that may take place. If reasons or any thing like reasons can be alleged for leaving the body of the Exchange entirely exposed to the weather, let them be stated and then we shall know on what grounds it has been determined to adhere in the new building, to what many considered an inconvenience in the former one.

There is, I find, an article on the Royal Exchange in the Penny Cyclopœdia, in the course of which objection is made to the merchant's area being left uncovered in the new structure. What is there said, however, is not likely to attract attention—at all events not immediately, or so much as a few lines in your Journal.

I remain, &c.,

CIVIS.

London, April 14, 1841.

MR. MUSHET'S PAPERS ON IRON AND STEEL.

SIR—I lately had for the first time an opportunity of looking into Dr. Ure's very elaborate dictionary, and on referring to the article on Iron I was a good deal surprised to find that a table of the proportions of charcoal used in the fusion of bar or malleable iron to produce the various qualities of steel and cast iron, and published by me in the Philosophical Magazine nearly 40 years ago, had been subjected to severe and unmerited censure on the part of Dr. Ure for its want of accuracy.*

As this table (along with many papers principally on the subject of iron) has lately been republished at a very considerable expense, I consider it behoves me to protect the property so created, and to take care that where the work is free from error, it shall not suffer any deterioration by my silence in respect of the criticisms of others, in whatever spirit they may be expressed.

The criticism to which I allude (page 716 of the second edition of Dr. Ure's Dictionary), is evidently borrowed from Karsten, but as the matter does not stand in the Dictionary in inverted commas, I am entitled to assume that it contains Dr. Ure's opinion on the subject, and shall deal with it accordingly. It is as follows.

"According to Karsten, Mushet's table of the quantities of carbon contained in different steels and cast irons is altogether erroneous. It gives no explanation why, with equal portions of charcoal, cast iron at one time constitutes a gray soft granular metal, and at another a white hard brittle metal in lamellar facets. The incorrectness of Mushet's statement becomes most manifest when we see the white lamellar cast iron melted in a crucible lined with charcoal take no increase of weight, while the gray cast iron becomes considerably heavier."

In this extract two facts are alleged, namely, first, that the product obtained at different times by the fusion of the same quantities of the same iron with similar proportions of charcoal is irregular: and secondly, that gray cast iron acquires weight by its fusion with charcoal, while white iron does not. I deny both these allegations,—but supposing they were true, what has my table of proportions to do with them?

It is assumed by Dr. Ure that the table gives the atomic proportions of carbon *united with*, and *existing in*, the various qualities of steel and cast iron, whereas it only professes to give the proportions of charcoal required to be *presented to* bar iron in the crucible to afford the various qualities of the metal before alluded to, and this it does with a degree of accuracy which I challenge Dr. Ure and Karsten to disprove.

The experiments show in the clearest manner that charcoal is absorbed by iron; that gray iron absorbs a greater quantity than white, and that steel requires for its production a less proportion than white.

To guard against the inference which has been so inconsiderately drawn by Dr. Ure, the following passage was inserted in my work.*

"Although this is the quantity of charcoal necessary to form these various qualities of metal by this mode of syntheses, yet we are by no means authorised to conclude that this is the proportion of real carbonaceous matter taken up by the iron, seeing that in experiments Nos. 1 to 6 inclusive, the weight gained by the iron was upon the average equal only to 1-21$\frac{8}{10}$ part, whereas the charcoal which disappeared in the different fusions amounted to 61¼ per cent. of the original quantity introduced along with the iron."

Having in this paragraph taken the precaution to guard against misrepresentation, I am at a loss to account for the conclusions at which Dr. Ure has arrived.

It is quite evident that both he and Dr. Karsten are puzzled with some results for which they have not been able to account. They cannot, it would seem, explain why "cast iron (query, white, gray or motled) with the same proportion of charcoal sometimes makes white iron, and sometimes gray." Having had some experience in the treatment of iron, it is barely possible that I may be able satisfactorily to solve the difficulty, the weight of which they have flung upon my table of proportions.

I must in the first instance be allowed to deny the alleged fact, namely, that the same iron and charcoal are so capricious as at one time by their fusion to produce white cast iron, and at another time gray. The same substances which have once made gray iron will, if the operation be similarly conducted, do so on every occasion, and the same remark holds good in respect to the other varieties of the metal.

In order to understand this curious and not unimportant subject, it must be laid down as a maxim that the affinity between iron and carbon depends upon the degree of temperature which the iron will withstand before it enters into fusion: the higher the temperature short of fusion, the more rapid and extensive will be the combination: and the converse is equally true.

Hence the unerring certainty with which malleable iron and steel unite with carbon in the crucible, and become with an increase of weight rich carburets of iron. The same remark is applicable in degree to refined metal, which when of the purest and whitest fracture, will with its appropriate dose of charcoal also pass into the state of the most perfect gray iron. But the case is most materially altered when the experiment is performed with common white pig-iron or with gray: the greater fusibility of both these states of the metal does not leave time for the action of affinity to take place between the iron and charcoal, so that even with a higher proportion of charcoal the results come from the crucible to all appearance unchanged as to quality.

* See Mushet's papers on iron and steel, published last year by Mr. Weale.

* Page 526, towards the bottom.

This difference in the fusibility of the various states of iron affords a clue to the mystery which seems to have puzzled Drs. Ure and Karsten, who may perhaps have still to learn that charcoal never combines with iron after it has become fluid, and that the union is always effected by a process of cementation.

Suppose then that an experimentalist were in the first instance to fuse refined metal (which is the whitest of white iron), with a certain portion of charcoal, and to obtain a soft gray granular metal, this result would be uniformly obtained so long as the same substances were used, but were he to substitute for the refined metal, white cast iron, (which, to an unpractised eye, is not easily distinguishable from the other), and fuse it with the same, or with a greater quantity of charcoal, the result would not in this case be gray, but white cast iron, of the same appearance as when introduced into the crucible.

But it by no means follows that white pig, or cast iron, cannot be converted into gray iron in the crucible, for however great its fusibility, yet if a portion of those earths whose affinities for carbon are developed at page 553 of my work, be introduced into the crucible and fused along with white cast iron, and even a minimum doze of carbon, the result will be gray iron of the best quality. In short the same iron which when fused with half its weight of charcoal alone, comes out of the crucible white, will by the introduction of the earths be converted into rich gray iron with an increase of weight, and this result will be obtained with only $\frac{1}{25}$ or $\frac{1}{30}$ of its weight of charcoal.

Your's, &c.,
D. Mushet.

(To be continued.)

THE LARGE WATER WHEEL AT COLEBROOK DALE.

Sir—Thinking a short description of a water-wheel of no ordinary dimensions may be worth your notice, I send a slight sketch and a few of the principal dimensions of one erected in Colebrook Dale, Shropshire, it works an oil and colour mill, but as the speed and the supply of water vary considerably, no correct estimate of the power can be obtained, but it probably does not exceed 3 or 4 horses' power. The speed is generally about one revolution in three minutes, or 1·39 feet per second; part of the water comes on to the wheel at the top and part about 25 feet lower down.

Fig. 1.

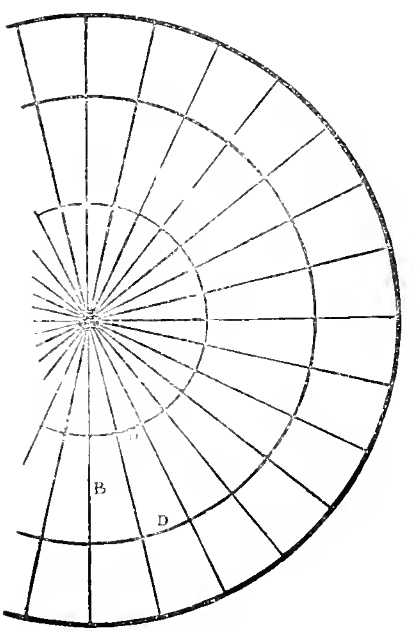
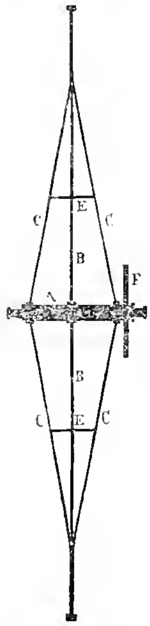


Fig 2.



The principal dimensions are as follows:—diameter out to out, 80 feet, 28 arms B, 8 inches by 3 inches; side stays C, two to each arm, 4 inches by 3 inches; the arms and stays are braced together by two circles D D, 4 inches by 3 inches; and by cross stretchers E, of the same dimensions. The buckets, of which there are 280, are 9 in. wide at the top, 5 in. at the bottom, 16 in. in breadth, and 10½ in. deep. The shaft A is of cast iron hollow, 14 ft. 8 in. long between the bearings, 26 in. diameter, with mortice holes cast in to receive the arms and side stays. The arms are of pitch pine, all the other parts are oak. The spur wheel F is 15 feet diameter. The breadth of the lines in the drawing are as near as may be the dimensions of the different parts.

Fig. 3.

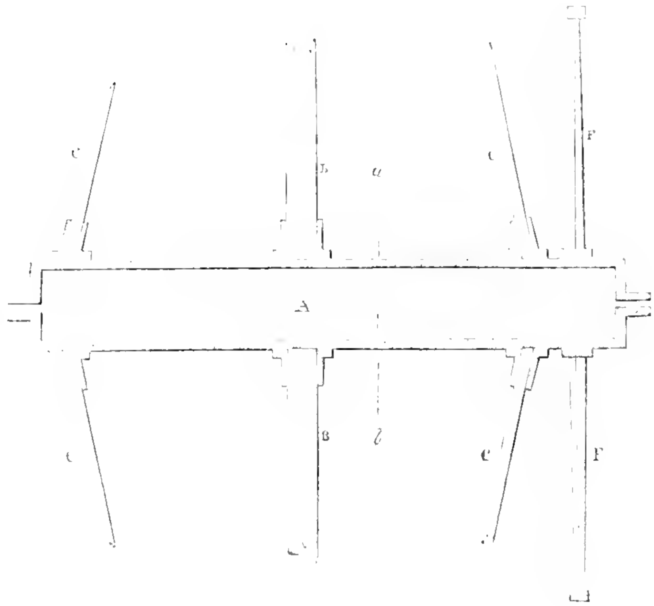


Fig. 4.

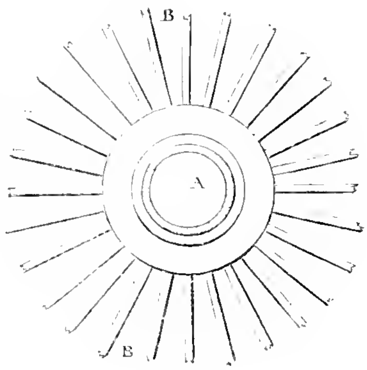
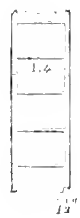


Fig. 5.

Fig. 6.



Scale of enlarged parts figs. 3, 4, 5, 6—quarter inch equal to a foot.

Fig. 1 is an elevation of the wheel; fig. 2 a section; fig. 3 an enlarged section of the shaft A taken longitudinally, showing the manner in which the arms B B, and stays C, C, C, C, are fixed, and the spur wheel E, E; fig. 4 a transverse section of the shaft from a to b, showing the arms; fig. 5 is a section; and fig. 6, front view of the buckets.

I remain, &c.
H. C.

Railway Works in France.—The Havre Journal, in noticing the arrivals of wagons and workmen for the Paris and Rouen Railroad in that port, says that the wagons have been hired from the London and Southampton Company at a much lower price than they could possibly have been in France, and that the workmen who have been sent over, are all chosen from the most sober and laborious of their class that could be found in England. This journal takes the opportunity of pointing out the activity and energy shown by the English engineers, and the Paris and Rouen Company, and holds up their example to the notice of all engaged in France on similar works.

CAPTAIN CARPENTER'S PATENT QUARTER PROPELLERS.

In the Journal for February last, page 56, we gave an abstract of the above patent, we are now enabled through the kindness of the Editor of the *Mechanics' Magazine*, to give the annexed engravings, which better explain the action of the Propellers, together with an account of some experiments communicated by Captain Carpenter.

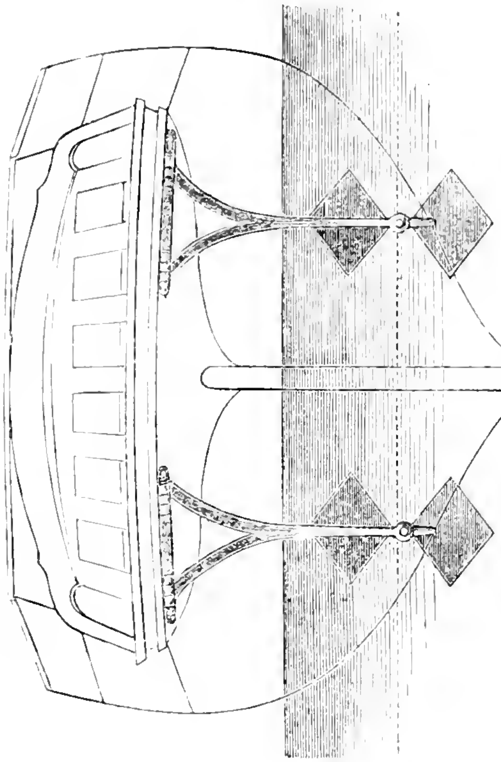


Fig. 2—Stern view

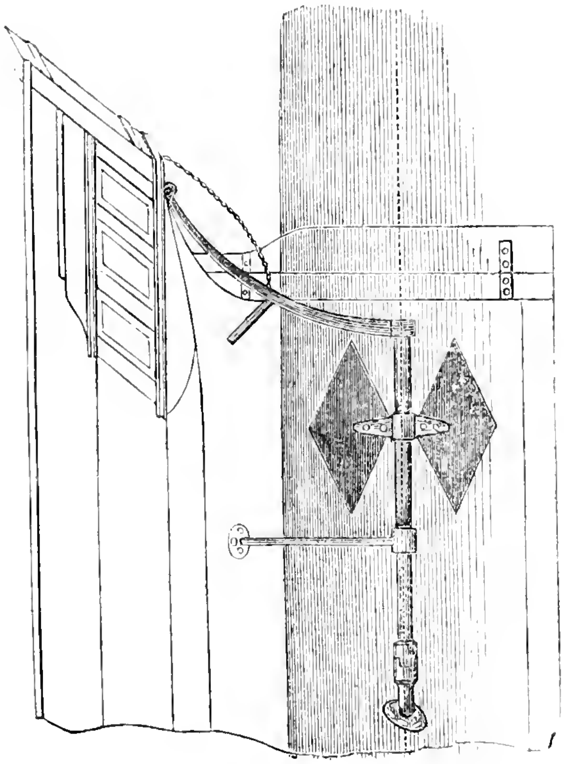


Fig. 1—Side view of the Propellers.

"The first experiments (on any thing like a large scale) were on board the *Aerolite*, a vessel 69 feet long, and 9 feet beam. They were intended only to ascertain how far the apparatus was adapted to sailing vessels, for the purpose of moving them about in calms, or as an auxiliary to the wind and sails. The powerful effect produced by the rotation of these 'quarter propellers,' even by manual power, was enough to establish the fact, that any vessel, however large, may be moved in an opposite direction to that line in which the force is applied, quicker or slower, according to the extent of the motive power.

"The next experiments were made with a model of a steam-boat, which is now exhibited at the Polytechnic Institution. This model is supplied with the means of applying a great variation of power to the propellers, and it admits also of great variation in the shape of them, by which means I have had an opportunity of judging upon the merits of screws, sections of screws, and planes; and of testing the angle of incidence, the shape of the vane or blade, and the relative proportions they should bear one to the other, according to the power applied. Although a screw is decidedly a powerful instrument in the water, I must nevertheless give the preference to the plane and to the figure shown in the accompanying drawing, because it produces the greatest speed with the least sacrifice of power, more especially when the vanes are set at the angle of 30 or 35° to the axis of the shaft. And here I would remark, and hope without presumption, that if any merit may be attached to this part of my invention, it consists in the discovery by careful experiment, that a plane having the proportions of my propeller, as represented in the drawing, will, when set at the above angles, and revolving in the water, impel a vessel by means of a locomotive power, and the resistance offered by the fluid, with a greater effect than any other instrument yet adopted in navigation, which may be proved by mathematical demonstration.

"The next experiment was made in a boat 21 feet long, and 4 feet 8 inches wide. It is necessary here to remark, that only one propeller was used, and that was placed in the stern. The object of which was, to test the shape of the triangular propeller against the screw, and other propellers with the same power, the same position, and the same machinery; but it is so difficult to make everything bear in an equal proportion, that I doubt whether the experiments can be considered conclusive. I do not apprehend there would be so great a difference as 3 to 6 between Mr. Rennie's propeller, Mr. Smith's screw, and my triangular propeller, as stated in your journal, if the experiments could be made equal in every respect, but that is impossible. Mr. Rennie's experiments, I believe, were made in a heavier boat than the one I used; and although there may not be much difference in the area of the midship section, still as there might have been a difference in the strength of the men and other circumstances, I do not think a comparison could be established; I therefore only presume to give you for data this fact, that with the very same propeller as I now send you, the boat was propelled with two men turning the winch, 88 measured yards in 33 seconds, and sometimes in timing it, it appeared to be 30 seconds—the propeller making 119·5 revolutions in that time."

"A screw propeller placed in the dead-wood of the *Archimedes* Yacht, has, it would appear from the public papers, fully established equality of speed with the common paddle-wheel. This propeller differs in *form* and *position* from the '*quarter*' propellers to which this paper immediately appertains, but the *principle* is the same; and on the ocean it establishes that main that principal fact, which the small model in the Polytechnic Institution under all its disadvantages also fully bears out—'*equality of speed*,' even in these early and imperfect essays. In the '*quarter*' propellers applied to this model will be found, a more direct and faithful adherence to nature's prototype, and in their rapid rotatory action in the water, under the most favourable angle of incidence the blades display, the combined powers of wedge and screw. No back-water ruffles their silent course. A gentle undulatory ripple marks the tract described by each propeller, similar almost to that which follows the action of the tail of a fish when swimming rapidly near the water's surface. The same obedience to the helm with equal facility of backing astern may also be observed, and in case of accident to the rudder, the power of steering is practicable by their alternate and combined actions."

Eastern Counties Railway.—On Wednesday the 7th ultimo, the first stone of the New Bridge over the river Chelmer, in the parish of Springfield, about to be erected to connect the embankment of the Eastern Counties line, which has been some time in the course of formation, and which is now traversed by means of a wooden viaduct, was laid by Mrs. Braithwaite, the lady of John Braithwaite, Esq., the engineer-in-chief to the company. The design for the bridge is distinguished by that neatness which characterizes those already erected upon the line, and will consist of three arches, each of 45 feet span. It will be 43 feet in height from the surface of the water to the coping. —*Kent and Essex Mercury.*

MESSRS. HANCOCK AND PETTIT'S PATENT RAILWAY TRAIN CONTROLLER.

(From the Railway Times.)

Fig. 1.

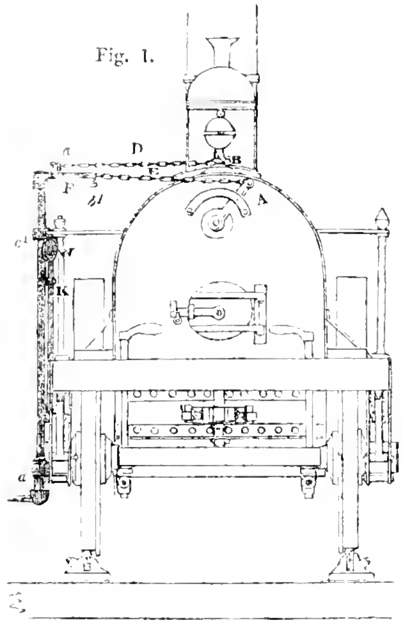


Fig. 2.

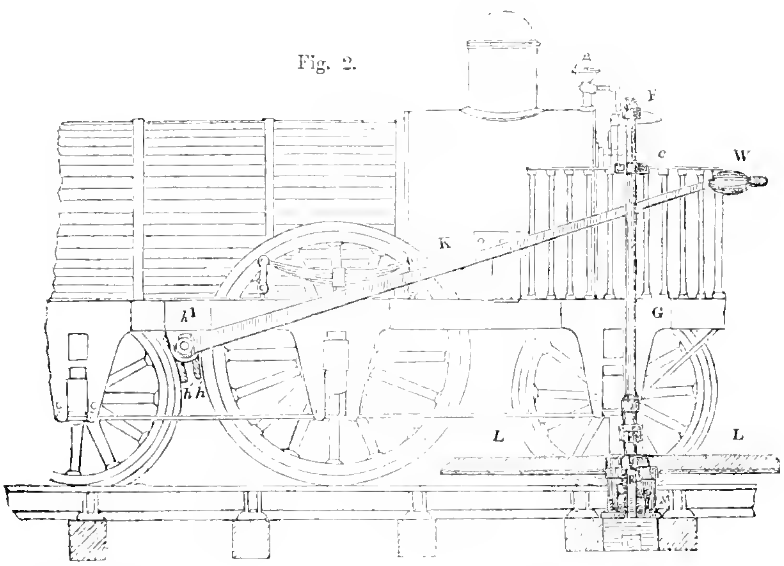


Fig. 3.

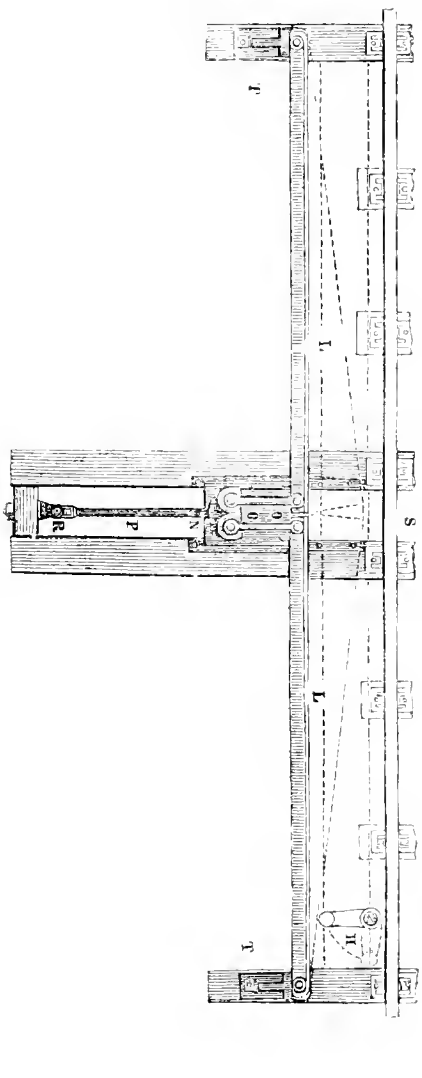
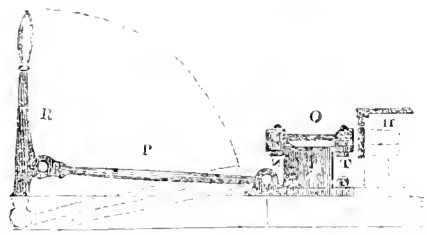


Fig. 4.



THE invention* is described as consisting in "certain mechanical contrivances and arrangements, by means of which common railway trains running upon railways of the ordinary construction, may be always brought to a stand without the agency and independently of the will of the engine-driver, guard, or other person or persons thereon, or travelling therewith, and at any given distance from a station or at any part of a line where it may be deemed advisable to have such independent means of stoppage provided."

The "mechanical contrivances and arrangements" divide themselves into two branches, the first including those which relate to the engines and carriages, and the second those which relate to the road-way.

I. The additions proposed to be made to locomotive engines for carrying this plan into effect are represented in the accompanying engravings, figs. 1, 2, 3, and 4.

Fig. 1 is an end elevation of a locomotive engine with the apparatus attached, and fig. 2 is side view thereof; fig. 3 is a plan of one of the rails and apparatus attached on the ground, fig. 4 is a side view thereof. A is the handle of the steam regulator, and B is the handle of the steam whistle. These handles are each fitted with loose collars, but so as not to interfere with the common mode of using them by hand; each collar has a projection to which the ends of the chains D and E are attached respectively, F is a horizontal lever fixed upon the spindle G, carrying the pins *a* and *b*, and to the two loose collars on these, the other ends of the chains are connected in like manner. The vertical spindle G is secured near the top by the bearing *c* fixed on the projecting rail; from this it descends through the eye *d*, attached to the guide plate of the axle on which it is supported by a collar, and H is a crank lever fixed on the lower extremity.

"When the engine is running, and the whistle shut, the several parts described are in the exact position shown in the drawing, viz. both

* The patent is in the name of Mr. Pettit, but Mr. Hancock and Mr. Pettit are joint proprietors of the patent right.

the chains D and E strained tight, and the crank lever H standing out at a right angle to the side of the engine.

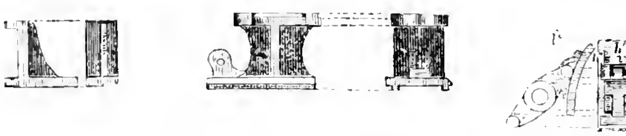
"Now, it is obvious that by fixing any apparatus on the roadway outside of the rails, by means of which the lever H may be pressed against, as the engine passes, to the extent of turning it about one quarter of a revolution, which will cause the two chains D and E to move with it, the steam will be shut off from both the cylinders, and simultaneously turned through the whistle.

"It may be proper, however, here to point out, that although the steam regulator, and whistle handles A and B, are connected to the lever F by chains, yet those handles can be worked by hand independently, either for the purpose of shutting off or putting on the steam to the engines, or blowing the whistle in the usual manner, leaving the crank lever standing in the position of fig. 1.

"Rods sliding in tubes on the principle of the telescope, admitting of the requisite contraction and expansion of the intervening distance, may sometimes be found convenient substitutes, for the chain D and E or any other suitable contrivance may be employed. A vertical instead of a horizontal action may be given to the lever by fixing it on a short horizontal axis, connected to the top of the spindle G by a small pair of mitre wheels, and supporting it by bearings fixed upon the most convenient part of the engine or carriage, or by any other mechanical means as circumstances may require."

II. The apparatus proposed to be affixed to the roadway to act on the combination of levers which has been just described, is also represented in figs. 1, 2, and 3, and in further detail in figs. 5, 6, 7, and 8.

Fig. 5. Fig. 6. Fig 7. Fig 8. Fig. 9.



"There are four sleepers of sufficient length to extend from under the line of rails to receive the apparatus fixed upon them in the manner shown in the fig. 3. Upon the two outside ones are bolted the blocks T T, of which figs. 5 and 6, represent an end and side elevation. The two middle sleepers are connected together about a foot asunder by the cross piece, and they form beds fortified with plates for the carriage N to slide upon; figs. 7 and 8, represent an end and side elevation of this carriage, showing two ribs cast upon the bottom to drop between the beds for the purpose of keeping the carriage in a proper position, during its backward and forward travelling motion. L L, are two pieces of strong angle iron, though any suitable material and form may be employed, which move on entire pins, fixed in the top of the blocks T T, while their other ends rest upon the end of the sliding carriage N, to which they are coupled by links O O, moving on centre pins fixed in the back end of the carriage N. One end of the rod P is received by the jaws cast on the carriage N, in which it moves freely upon a pin, and the other end is forked, and forms a movable joint with a piece or tongue projecting from the edge of the lever R (see fig. 4), and the fulcrum of that lever is fixed to the cross timber morticed into the sleepers, fig. 3. By joining the connecting rod P to a piece projecting from the edge of the lever R, the lever and rod, when the lever is put down will form a line occupying the position marked by the dotted lines in fig. 3.

"In the position in which the apparatus is shown in fig. 3, the pieces L L, or the slants as they may be termed, are parallel to the rail S: and, of course, stand clear of the crank lever H, which is carried by the engine (see fig. 1), but when it is necessary to act upon the lever H, in order to stop the train, the lever R must be depressed, which operating on the sliding carriage N, through the intervention of the rod P, advances or thrusts it forward together with the centre ends of the slants L L, towards the rail S to the extent of the dotted lines (see fig. 3), which are then in the position to act upon the crank lever H, when brought into contact by the advance of the engine.

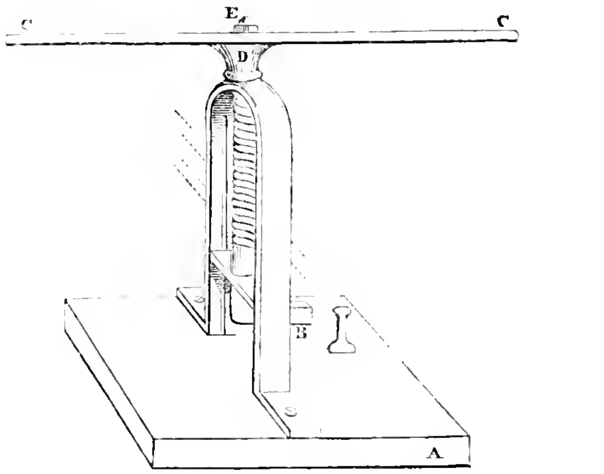
"The break lever K, figs. 1 and 2, moves inside of, and is suspended when out of action on, a projecting stud, inserted in the vertical spindle G. W is a weight to increase its power, or a spring to press upon the lever may be employed for the same purpose; this lever is fixed upon a short spindle passing horizontally through, and having its bearings in two plates, K, bolted to the engine frame, one within and the other without; of these, the outside one only, *k*, is visible in fig. 2, and upon the inside end of the spindle is fixed a short cross lever, the position and form of which is shown by figs. 8 and 9. The ends of this lever, K, bear upon the breaks *h h*, when the lever K is down, but each end has two cross pins under the straps *l l*, secured and screwed on the breaks for lifting them off the wheels on raising the lever K. These breaks are brought into action by lowering the lever K, occasioned by the removal of the supporting stud on the vertical spindle G, which is effected when that spindle is turned by the crank lever H, coming into contact with the slants L L in the manner before described."

The machinery last described is stated to be as applicable to the breaks, attached to the different carriages in a train, as to the locomotive engine; "especially upon such breaks by means of a spindle similar to the vertical spindle G, in the manner before described."

The lever R that brings the stationary apparatus into use may be worked by hand by any of the policemen stationed on the line, or other person appointed for the purpose.

The claim of the patentee is as follows:—"I declare that though I have specified under this head those contrivances and arrangements by which I think the objects in view may be best accomplished, and mentioned also certain contrivances which may be substituted for some of those so preferred by me, I declare that I do not confine myself to the precise arrangement and construction of the parts shown, as they may be varied under different circumstances without departing from the nature of my invention, but I claim a right to all variations and modifications of the same, and to all substitutions of equivalent means, either in whole or in part, by which the like effects may in the same general way be produced. And I declare, that what I claim generally is the addition to railway engines and carriages of such a combination or system of levers connected with the steam cylinders, alarums, and breaks, that being acted on in the direction of the line of motion, they shall simultaneously, or nearly so, shut off the steam, sound the alarums, and bring the breaks down on the wheels, and also the fixing to or placing on railways of an apparatus such as that before described in such a position that it can be made to act on the said levers in the direction of the line of motion, (by some projected part or parts thereof) without the agency, and independently of, the will of the engine-driver, guard, or other person or persons on the engine or train required to be stopped. And I claim both of the mechanical means, or system of means, last herein generally claimed, whether used together or used separately, that is to say, whether both are used together as I have described, or one of them only in combination with some other and wholly different means, or system of means, from that which I have specificed."

THE PLATE-LAYER'S SCREW.



Sir—If the above rough sketch of an instrument for lifting the rails, &c. on a railway, for the purpose of repairs, be thought of any service to you or others, for whose assistance it was contrived, (the platelayer), you are at liberty to use it in any way that you may consider it deserves. The instrument is now generally used among the platelayers on the "Great North of England Railway," near York, and is found to answer the purpose exceedingly well. The bottom A, is inserted sufficiently below the bottom of the rail until the claw B, can be applied under the rail, when the instrument is screwed up by the handle C C, lifting the rail and blocks at the same time, when high enough, the plate-layer or repairer commences beating the under side of the block solid. The female screw is in the base of the cross lever at D.

Your's, &c. M. Q.

York, April 9, 1841.

THE ARCHITECTURE OF LIVERPOOL.

Sir—In the outset of my remarks on this subject I avowed my intention of preserving, to the best of my ability, a spirit of candour and impartiality; and I should feel that I was very far from acting up to this pledge did I not endeavour to make the best amends in my power for any injury or injustice which, however unintentionally, may have been done to the works noticed, or their authors. Overlooking under the circumstances, the acrimony of expression employed by Mr. Corbett, in his letter published in your last number, and giving, as I feel bound to do, the fullest credit to his disclaimer of having taken any unfair advantage in carrying out his design for the North and South Wales Bank, by examining those of his competitors, I claim from him credit for equal sincerity, when I declare that no idea was ever farther from my mind than that of sheltering myself under a saving clause, for the purpose of asserting any thing of which I doubted the truth. I further assure him that it gives me unfeigned pleasure to find him so entirely denying the charge, and that I sincerely regret having given publicity to such an imputation, which however, I must in justice to myself be permitted to say, would never have been the case had not the report obtained such general credence among those interested in the matter, as left me, as I then thought, no ground for doubting its truth. As regards the committee, the case is by no means so clear; and without intending in any way to connect Mr. Corbett's name with proceedings of which he professes entire ignorance, I maintain that judging from his building as executed, and from the designs he submitted in two later competitions in this town, as compared with the known ability of several of the competing architects, it is difficult to conceive how, except by the exercise of some private influence, the decision of the committee should have been unanimous in his favour. Competition committees, however, are in their movements among the most eccentric and inexplicable of bodies, and it is vain to attempt arguing on their sources of action by the rules commonly applicable to organized matter.—With respect to the limits of cost, and the time the plans were in the hands of the committee, I spoke to the best of my knowledge and recollection; and still think that part of the designs at least were six weeks in their possession, and that the sum of 5000*l.* was *named* as the proposed amount of expenditure, but I suppose from Mr. C.'s plain assertion, not so advertised.—My mistake as to the position of the back wall of the portico, arose from the view obtained through the open doorway, of the wall of the vestibule next the bank; and such is the confusion of lines, arising from the number of features which are crowded into this narrow space, when seen in passing close to the front, as was the case with myself, that the most unequivocal impression remained on my mind that the case was as I stated it; and I was not singular in this idea. The door is now I see in its place, and this deception is corrected; but the pediment, which, as Mr. Corbett will perceive on reference, I mentioned as *principally* marking the obliquity of plan, remains unalterable, and its effect in this respect is most undeniable, as any one may prove by trial with a block model. I hold my first opinion as to the waste of valuable space caused by the use of columns and pilasters; and though the privilege of advancing the bases a few inches over the footway had at the time slipped my memory, the fact is certain that *room is sacrificed*, and the public thoroughfare contracted, for the purpose of employing a mode of decoration most unsuitable for a building of such proportions, and by this means cutting it up into a series of narrow strips, into which the necessary openings must be crammed as they best may.—If Mr. Corbett acknowledges, as by his silence on that point he in substance does, that the sketches sent you are fair representations of the proportions of his building, I may safely leave the question of its merit in point of design to the judgment of your readers; and trusting that the "judicious Eder," and the "many" admirers mentioned by Mr. C. may long remain the sole advocates of such a style as the Bank exemplifies.

I remain, Sir, your's obcdiently,

H.

Liverpool, April 12, 1841.

ON THE EMPLOYMENT OF MILITARY ENGINEERS.

Sir—The perusal of the article in your last number on the subject of the employment of military engineers in positions to dictate to the civil professional practitioners, has called into expression my own long dormant feelings upon a very similar subject.

It has been my lot to have had the means of observing, rather intimately, the working of the civil engineering and architectural operations of the Ordnance and Admiralty departments of the public service, upon which subject I beg permission to offer a few remarks.

It is well known that a set of young gentlemen dignified with all the notions of embryo-officers, are drilled through what is called a "*course of civil architecture*," under the auspices of a *colonel* at the Royal Military College at Woolwich. When lectured through this educational course, under the instruction of their Military Commandant, and made very clever in copying drawings, they obtain their Lieutenant's commission, and become at once, and as a matter of course, endowed with the necessary qualifications for designing and executing all the details of the civil engineer and architect's profession. They are stationed at an out-post under a staff of colonels and captains, and are expected to make drawings, measure artificers work, abstract, price, and enter into all the minutiæ of a civilians practice. They pretend to great efficiency and usefulness, and are very apt in signing at full length their names and designations to the designs, &c. of which they are supposed to be the authors. But it happens that to every station there is attached an humble ill-paid individual usually emanating from the carpenter's bench, and rising through the grade of Foreman, to what is called the Clerk of Works. He and he alone is really the designer, the estimator, and measurer, the every thing but the signer. He, though generally himself most incompetent to perform the lowest duties of the architect's profession, is yet sufficiently in advance of his military masters to do all the work for which they get the credit. With all the innate idleness of military men, added to a professional pride which raises them above the indignities of actual practice—with no inducement to, and no necessity for, that incessant application to details which can alone impart information and lay the ground work of professional acquirement, they saunter through the subordinate ranks, till at once getting the rank of colonel of engineers, they are fit for any thing!

Barristers of 20 years standing, whether they ever held a brief or not, are duly qualified for most things, but a colonel of engineers beats them hollow, their very rank endows them with that excellency of skill, that pre-eminence of knowledge, that loftiness of science which marks them as the class by which not only the public departments connected with civil engineering and architecture are to be controlled, but from which commissionerships of all sorts are to be formed to discipline—to dictate to—and to degrade—men, whose individual energies have done more to elevate their country in the scale of nations, and whose efforts have been more successful in developing its resources, and in promoting the industriel happiness of its people, than those of any other body, of whatever class, or of whatever pursuit.

At this moment we have a captain of engineers at the head of the architectural and civil engineering departments of the Admiralty, a man who alone and unassisted is incompetent to execute with decency the most ordinary architectural performance—a man who has only the most general smattering of architectural knowledge, who, if he had to pass an examination, with an attentive pupil of four years standing, would be disgraced; and yet this man is at the head of a department in which hundreds of thousands of the public money are annually expended.

But perhaps it will be said hé is only the director-general, in whom a tact in the management of business, and a soundness of judgment upon ordinary subjects, is more important than the knowledge of professional detail. He who knows most of his profession most highly, values this description of knowledge—but be this as it may, let us see who are the working men. At nearly every dockyard there is stationed a resident lieutenant or captain of engineers, one of the class before alluded to, who lords it over a few foremen, and perhaps a clerk of the works. These men have no practical acquaintance with the value of materials or the cost of labour, their knowledge is confined to the experience of government work, and they are under the necessity of confiding in persons whose direct interest it is to abuse their confidence, and to make the most advantageous bargains for themselves. If competition be had recourse to, it is well known that contractors who have to deal with men ignorant of the usages of private business, and from that ignorance open to abuse, have a thousand ways of taking advantages which the experienced practitioner would readily detect.

Why should not these military architects and engineers be called upon to submit to public examination before their appointment? I know of one of these functionaries who, when first appointed to conduct works amounting to from 12 to 20,000*l.* a year, was unacquainted with the commonest professional terms. The candidates for country engineers in Ireland have to pass a severe examination. The candidates for private employment are constantly subject to the test of severe competition, and why is the same course not adopted with respect to these mighty men? Does their rank oppose so insufferable an indignity? or does it not signify whether they be qualified or not?

Z

since if they fail, if they squander the public money, its *only* the public who suffer, and nobody feels it.

It may be asked what is the practical evil of all this? Some of the evils which I have observed are, that the director of works puts himself under obligations to the more experienced builder for the information which he lacks; deplorably ignorant himself, he draws from him his ideas, and gets into the habit of *depending upon* the very man whom he should be in a position to *direct*. One result of this is, that money is wasted in useless strength, or in the adoption of expensive methods and expensive materials. The self-styled engineer feeling no confidence in his own knowledge, and desirous above all things to avoid the onus of a failure from want of strength, is induced to lavish expenditure in the attainment of security beyond all necessity, and even beyond all decency. And so our government works instead of deriving all the benefit of the experience of private undertakings, are usually conducted in a manner altogether in arrear of the knowledge of the times.

Instead of employing persons competent to design public works, and well acquainted with the most advantageous mode of getting them executed. If any matter demanding superior skill be required, such for instance as a swivel bridge (as was recently the case in the Plymouth Dockyard), a manufacturer is invited to submit his *design* and tender, and the work costs 40 per cent. more than it would if competition tenders had been called for upon a specific design. But who is to make that design? how is it to be had if the persons employed in the engineering department, whether chief or subordinates, are incompetent to its production? and if incompetent to such a work, how fit are they for the office which they hold?

How does it happen that these things are so? That the most competent man that can be found as the Surveyor of the Navy, whose office it is to construct ships, and to make drawings, and enter upon all the elaborate calculations required in such an important work, is *not* a profound mathematician, who having great mechanical skill, and having directed his entire education to that pursuit, is well informed upon all its manifold mysteries—*not* a practical ship builder who, having a scientific mind, and gifted with intelligence beyond his fellows, has attained the theoretical and mathematical knowledge which forms the necessary qualifications of an accomplished naval architect—*not* either of these, but a *Captain in the Navy*, a man who knows as well how to build a ship, as a prince does a palace, or an archbishop a cathedral. Many gentlemen who have always lived in good houses, and noted their conveniences or defects, fancy themselves very skilful in arranging the apartments of a mansion, and sufficiently knowing for all the measure of taste that they think necessary for its embellishment; they build after their own designs, and under their own management, and whether *they* find it out or not, all their friends discover that their deep solicitude for some darling "bijouterie" has spoiled their house, that they have sacrificed their comfort and their purse to their conceited notions: and yet the Captain in the navy has lived in a ship from his boyhood, has noted all its good or bad points, and is not he the man to build a ship? he may build and he may alter, and he may be very successful in attaining some one point of excellence, but at what cost? let the naval expenditure tell, and it *could* tell some very deplorable tales upon this subject; it could tell at what *cost* the country has progressed with the education of our Captain-Surveyor, what has been paid for his experience, and how dearly we ought to prize it. This, Sir, is part of a system which is overrunning all the departments of the public service, we are becoming a military-ridden people in matters essentially civil. Naval and military men hold together and assist each other to the degradation of all the branches of the civil service. Their rank is a passport every where, and gives them a position which is not readily yielded to civilians, of whatever merit: existing upon patronage, they nurse it and cherish it as their best friend, and whatever of it they have to disperse, they take good care that it shall flow into the prescribed channel of their own order.

I do not expect that writing upon this subject will be of much practical utility, and I hate agitation, but it is high time that some notice of so wide-spreading an evil against the profession which your Journal so ably upholds, should find a place in its columns. It is the more important that it should do so now, that we are told by the President of the Institution of Civil Engineers, that too many young men are crowding into the profession, which is overstocked with professors, while the field of their employment is diminishing. It may well indeed diminish, while the government departments overlooking the claims of men whose professional education has cost *them* seldom less than 1000*l*. are put aside by military pretenders, who after a few months dabbling in drawing, under the masters of the Royal College, are turned out finished, and fit for the best of every thing.

Verily I wish there were a tribunal at which these belted aspirants could take a tilt with *working men*. I would have them set alone, not even should the despised clerk of works lend his wonted and bashful glance—he should not only *sign* the design, but he should make it, and a very pretty business he would make of it.

Having brought my military professors into this predicament I am quite content to leave them there, and subscribe myself,

A Civilian.

RIVER SEVERN.

Report on the Proposed Improvement of the River Severn, between Gloucester and Stourport.

By William Cubitt, Civil Engineer.

The object of this report is to set forth the proposed plan and probable cost of the intended improvement in the navigation of the river Severn, from Gloucester to Stourport, agreeably to plans and sections lodged with the respective Clerks of the Peace, preparatory to an application to Parliament in the ensuing session for that purpose.

In its present state the river Severn abounds with shoals, which very much impede the navigation, so as to render it impossible for the vessels which navigate it to proceed with full cargoes, or in a long continued drought to proceed along the river at all, to the manifest disadvantage of all that portion of the public which has any interest in or dependence upon the navigation of the river Severn.

The object of the proposed plan is to obviate these difficulties, and to obtain a minimum depth at any time of not less than six feet of water in all parts of the navigation between the entrance lock of the Gloucester and Berkeley Canal, at Gloucester, to the entrance lock of the Staffordshire and Worcestershire Canal, at Stourport, and upon such principle as will in no wise interfere with the due and proper drainage of the adjoining lands, or the discharge of the flood water of the river as at present, except insomuch as both may be improved and facilitated by the measure.

The means by which this improvement is to be carried into effect, is by what are technically termed weirs and locks, of which there will be five of each between Gloucester and Stourport.

The effect of the weirs or dams in the river is to divide the whole fall of the low summer water between Stourport and Gloucester, into five steps or falls, and by a side cut or short canal (with a lock therein) round or past the side of the weir, the navigation is carried on in the same manner as in an artificial canal, whilst the river passes off over the weir at a depth or thickness proportioned to the quantity of water coming down, and the weir is so contrived as to height, length, and position, that whilst it will never let out the water of the river below the fixed navigable depth in time of short water, it will nevertheless afford a greater capacity for the escape of flood water than at present obtained in the same place; and as all the shoals in the river between the weirs are to be dredged out to make a uniform navigable channel, it must be evident that the capacity of the river for the discharge of floods must be increased and improved, whilst through the same means the low summer water will be prevented from running off below its present level at the foot of each weir; and from the low water channel being deepened at the shoals, the exit of the drainage water will be improved also, whilst the navigation will be at all times available whether it be drought or flood.

The total fall of the river at summer water, from Stourport to the entrance of the Gloucester and Berkeley Canal, is thirty-two feet in a total distance of forty-two miles, of which the lower portion from Gloucester to Upton Ham, (the site of the first weir), being a distance of eighteen and a half miles, the fall is only four feet, a quantity but little more than sufficient to carry off the water in the ordinary state of the river, the whole of which distance being subject to the influence of the tides, no weir or locks will be required within these limits, (that is, from the Upton weir downwards), and no other operations than dredging and regulating the breadth of the low water channel, to obtain the requisite navigable depth, will be necessary; and it may be further observed, that no dredging or deepening of the channel will be done on the Gloucester branch of the river below the entrance of the Gloucester and Berkeley Canal, or on the Maisemore branch lower down than the entrance lock to the Herefordshire Canal, and to no greater depth than the sill of that lock, and of sufficient breadth to admit the boats which navigate it to pass to and from that canal and the river at the Upper Parting respectively; by which means, and leaving untouched the remaining portion of both branches below the entrance to the Berkeley and the Hereford Canals respectively, it must be evident that no alteration will be made in the height or level of the surface water of the river up to the first weir in a distance of eighteen and a half miles above Gloucester; nor is it intended or required by the present proposition for obtaining a six feet navigation to erect any weirs or locks, or to do any works that may affect the height or level of the river below the weir at Upton Ham, or in any way to affect, alter, or interfere with the adjoining lands in relation to the river as at present existing.

Proceeding upwards, the next weir and lock are at Worcester, just below the entrance lock at the Birmingham and Worcester Canal, at Diglis, a point twenty-nine miles up the river from Gloucester; the third weir and lock will be Bevere Islands, four miles above Worcester, at a place where the river has two channels, in one of which will be placed the weir, and in the other the lock, by which the necessity for an artificial canal or side cut will be avoided.

the fourth weir and lock will be just above Holt Bridge, three miles and three quarters above No. 3; and the fifth and last, at Lincomb Hill, four miles and a quarter above No. 4, or just forty-one miles from the entrance to the Gloucester and Berkeley Canal at Gloucester, and one mile and a quarter below Stourport Bridge, making a total distance of forty-two miles and a quarter for the improvement of the river, and making a minimum navigable depth of six feet over the lock sills, without raising the usual summer height of the water in the river at the tails of any of the locks and weirs, or causing any obstruction to the passage of flood waters.

Such is the mode by which it is proposed to improve the navigation of the river Severn, and which may be more fully understood by a perusal of the plans and sections as deposited with the Clerks of the Peace, in which the details of the measure, as required by the standing orders of Parliament, are clearly and correctly laid down.

Adverting, however, to a meeting of the land proprietors along the Lower Severn, (viz. from Worcester downwards) held at Tewkesbury, on the 16th December, and a meeting of the parties interested in the navigation of the river Severn, held at Gloucester, in the evening of the same day, at both of which I had the honour of attending, and giving such verbal explanations of this measure as were then and there required; and with reference also to certain resolutions which were passed at those meetings, and at a subsequent meeting of the committee of landowners, to the purport generally of requiring more definite information in writing from the promoters of this measure, as to the nature and extent of the proposed works, and every particular connected with the undertaking, as regards not only the nature of the works, but also the constitution of the Association for carrying them into effect, and the amount of tolls to be levied for defraying the cost, and maintaining the undertaking, &c., it may be observed, that there are some points, perhaps, out of my province to answer.

In addition, therefore, to what has been explained already with regard to the nature of the works, it may be satisfactory to the parties making inquiries at the meetings above stated to state,

1stly. That there is no intention of taking land without consent of owners, along or on either side of the river, except at those parts shown on the plan as the situations of the locks and weirs.

2dly. That the weirs will be solid weirs, placed very obliquely across the river, and of such length that (with the requisite widening of the river at the spot) there will be a greater water way on any cross section of the river at the weir after its erection than before.

3dly. That the height of the weirs, as shown on the sections, will not raise the water in short-water seasons above the present summer level at the site of each weir next above respectively; and the depth of water to be maintained by dredging, is a clear six feet below a horizontal line extending up the river from the top of each weir respectively.

4thly. The locks are proposed to be not less than one hundred feet clear length within the chambers, nor more than twenty feet in clear width, with six feet water over the sills in low summer water.

5thly. The estimated cost of the works from Gloucester to Stourport is £150,000, of which, as nearly as may be, one moiety will be expended between Gloucester and Worcester, on a distance of between twenty-nine and thirty miles, and the other moiety between Worcester and Stourport, a distance of thirteen miles, or thereabouts.

6thly. As regards the tolls to be imposed, to meet the above expenditure, maintain the works, defray the current charges of management, and (as should be contemplated) raise a fund to pay off the original cost in course of time,—that is probably a question more suited to the committee of management than the engineer; the question, however, is in very narrow limits, and assuming the minimum annual amount necessary to be raised for the above purposes, of interest, management, and maintenance, to be £10,000, and which, in my judgment, would be but just sufficient without paying off any capital, it follows that the amount of tolls per ton must depend upon the quantity conveyed along the river both ways, between the three principal points (Gloucester, Stourport, and Worcester) respectively. Taking, therefore, the charge per ton from Stourport to Gloucester to be double that from Worcester to Gloucester, and assuming the minimum charge for the long length to be sixpence per ton for the whole distance, it will require 270,000 tons between Stourport and Gloucester, at sixpence per ton, and 260,000 tons between Worcester and the other two points respectively, at threepence per ton, to raise £10,000. But as various contingencies may arise tending to increase the annual cost, or to diminish the amount of tonnage; and as a liquidation of the first cost ought never to be lost sight of, I strongly recommend that powers should be taken to fix a higher toll than sixpence and threepence per ton for the whole and half distances respectively, and am of opinion that one shilling per ton for the whole distance, and sixpence per ton for the Worcester half either way, should be fixed as a maximum, beyond which the commissioners should not have the power to charge, and that sixpence and threepence should be the minimum below which the tolls should not be reduced till such time as the first cost of the works be either funded or paid off; and if provision were made that an additional sum were funded before the tolls be reduced, the interest of which would serve for wear, tear, and management, the river in its improved state might be looked forward to as becoming in time a *free navigation*.

7thly. Touching the constitution of the managing body, all I can offer on that head is an opinion many times urged on other parties when attempting to form a company for improving the navigation of the Severn, viz. that the improvement of this navigation should be carried into effect by commissioners under an act of Parliament, as a public rather than a private measure, and in such manner that the profit or emolument to be derived from the measure, should eventually go towards the reduction of tolls, and rendering the navigation free instead of being made private gain or individual speculation.

W. Cubitt.

London,
January 5, 1841.

Report to the Committee of Management of the Gloucester and Berkeley Canal, by W. Clegram, Engineer.

Gentlemen—In compliance with your instructions, I have carefully examined the plans now proposed for improving the navigation of the River Severn, from Gloucester to Stourport; and with the explanations which I have received from Mr. Cubitt, the Engineer, by whom the works are projected, I am enabled to report my opinion upon the subject.

It is most certain that the interests of the Gloucester and Berkeley Canal Company are deeply involved in the measure—few have more to gain, or more to lose, from the success or failure of it, than the Canal Company; and instead of confining my attention simply to the engineering department, I have endeavoured to take a general view of the whole subject, in order to ascertain what are likely to be its effects upon the welfare of the canal.

To come to a right understanding of the matter, it should be known, what are the existing inconveniences in the navigation of the river, and what would be a sufficient remedy

The obstructions to the *free* navigation of the Severn, arise from two causes, viz.: from too *great* a quantity of water in time of floods, and from too *small* a quantity in the summer season. The former is without a remedy. And it is to supply the deficiency of the latter that the plans of the "Severn Navigation Improvement Association," are proposed as a remedy. This deficiency of water is felt on an average, during three months in the year; and it is the opinion of nearly all the traders on the river, that, if a depth of four feet, or four feet six inches of water could be maintained throughout this period of the year, it would fully meet the wants of the trade.

To remedy these impediments, and meet these requirements of the trade, the "Severn Navigation Improvement Association" propose to obtain a depth of water in the river, throughout the dry summer weather, of from seven feet, to seven feet six inches between Gloucester and Worcester, and a depth of seven feet between Worcester and Stourport, by plans so nearly similar to those last proposed, and described in my report of the 12th December, 1837, that I need not here recapitulate the particulars, but merely state, that, it is to be effected by dredging away the shoals in the river between Gloucester and the first dam, which is situated just below Upton-upon-Severn, about eighteen miles and a half above Gloucester. This dam will carry the proposed depth to Worcester; and between Worcester and Stourport there are to be four other dams to give the depth of water to Stourport. The dams are to be passed by side cuts and locks. The locks are to be 100 feet long, 20 feet wide, and with six feet of water over their sills. The dams are to be solid, entirely across the river; but placed so obliquely across the stream as to offer the least possible obstruction to the passage of the flood waters. The entire cost is estimated at 150,000*l.* The maximum toll is proposed to be 6*d.* per ton from Gloucester to Worcester, and 6*d.* per ton from Worcester to Stourport; or 1*s.* per ton for the whole distance; to be equally levied upon the goods conveyed by all classes and description of vessels throughout the whole year. And the works, in execution and subsequent management, are to be placed under the control of Public Commissioners.

This is the plan proposed; and I cannot say that the opinion I have formerly expressed on the engineering defects of a former and similar plan is in the least degree altered with respect to this—for I consider it, as I did the other, inapplicable to any river similarly constituted with the Severn. For from the mountainous rise of the river—its rapid and precipitous course throughout a considerable portion of its length—from the accumulated waters of several rivers being poured into it, and thus being the drain of a very large extent of country,—its waters are not only highly charged with silt held in suspension in them, but vast quantities of gravel and heavy materials are brought down, and rolled over the bed of the river in a continuous stream. Any interference therefore (as would be the case by the plan proposed) with the bed of the river, that would destroy its natural powers of cleansing itself, must necessarily entail a heavy and constant expense to provide artificial means to get rid of the accumulations—for with the tidal deposits on the one hand, and the land flood deposits on the other the accumulations will be very great. I have not documents by me to refer to, but I believe the late celebrated Mr. Telford, when employed about the year 1824 or 1825 to offer some plan for the improvement of the navigation of the Severn, gave a similar opinion to my own. I know that he recommended the formation of a canal between Gloucester and Worcester, at a cost of 200,000*l.* which he was not likely to have done, had he considered the river capable of economical and permanent improvement.

But setting aside these engineering difficulties, there can be no doubt that the proposed works are on a much larger scale than is needed. The depth of water over the outer sill of the Gloucester and Berkeley Canal Lock at Gloucester, during the low summer water, being from 4 feet, to 4 feet 6 inches only, is quite the index of what the depth should be in the river; for it is clear, that vessels loading in the canal for the river, would not be loaded to a greater depth than that of the water over the sill of the lock through which they must pass; nor would vessels coming down the river at this season (however great the depth of water that might be obtained in the river) be loaded to a greater depth, and thus be subjected to the delay and inconvenience of the transhipment of a part of their cargoes before they could enter the canal. As a proof that the trade requires no greater depth than this, I may mention, that it is indeed a rare case for even the largest trows to be loaded, at any season of the year, to a greater depth than 4 feet, or 4 feet 6 inches, for navigating the river above Gloucester; and if it be said that this arises from the want of water, I would reply, that if it were more convenient or economical to sail these craft at a greater depth, it would surely be done during the nine months of the year when the depth of water is ample for it. I feel satisfied that if a depth of 5 feet, or 5 feet 6 inches at the most, of water, could be obtained, and maintained during these three months of the year, it would, for the considerations above set forth, be found fully sufficient. In this case, the whole of the works, the dredging, the dams, the locks, the cuts, the equalization of the area of the channel, all might be proportionately diminished, and performed at a considerably less cost. In dredging alone, about 150,000 cubic yards might be saved, (being upwards of one-half the whole quantity at the 7 feet 6 inches depth,) and the annual cost of management and maintenance would be much lessened; and I think it probable, that this diminished plan might be done and upheld at a cost that would not require the imposition of more than an equivalent toll for the benefit conferred upon the trade. The toll necessary to pay the interest on the money to be expended in carrying out the larger plans of the "Severn Navigation Improvement Association," and in upholding the works, I should fear would press very heavily upon the trade, especially as it would be levied throughout the year upon all classes of vessels, the greater part of which, from their light draft of water, would derive a comparatively small advantage from the measure.

These are weighty considerations for the Canal Company; and if it be, as I have frequently heard it advocated at your board when any suggestion has been made to raise the tonnages of the canal, that the smallest additional imposition of toll on those articles which form the bulk of the trade upon the canal would be ruinous to it, the same effect would result from the imposition of any toll for navigating the river, if it exceeded the limit of the loss sustained by the trade from the impediments existing in the navigation of the river.

The only other points that I have to allude to are—1st, that the notices of the intended application to Parliament are for power to improve the river from the *Lower Parting* upwards, whereas the deposited section shows an interference with the river only as low down as the lock of the Gloucester and Berkeley Canal in one branch, and the lock of the Hereford and Gloucester Canal in the other branch of the river. At the meeting with the promoters of the measure on the 16th of December last, an explanation of this discrepancy was asked, and it was replied that there was no intention to touch the river below the points above named, neither would they obtain power in their Act to do so. Secondly, the removal of the Maisemore shoal, in the Over branch of the river, to the depth shown in the section. This shoal, it was pledged, should only be removed to the depth and width necessary to accommodate the vessels navigating the Hereford and Gloucester Canal. It is most important to the interests of your canal that the parties should be kept to this; for any interference with the shoals between your lock and the Lower Parting, and with the shoals in the other branch of the river, would seriously diminish the depth of water in the Gloucester branch of the river, and consequently over the sill of your lock, and ultimately render it necessary to place the sill at a lower level, which, if ever needed, will be a work of considerable difficulty and expense.

For the reasons above stated, I can neither approve the *mode* by which it is proposed to improve the navigation, nor the *extent* to which that improvement is proposed to be carried; believing the mode inapplicable to the character of the river, and the extent more than is required by the trade.

W. Clegram.

Saul Lodge, 5th January, 1841.

Report addressed to the Committee of the Gloucester and Berkeley Canal Company, on a Bill now in Parliament for the Improvement of the River Severn. By James Walker, LL.D., F.R.S., L. & E., Civil Engineer.

Gentlemen—Since I received your resolutions and the communications from Mr. Brickwood, I have given my attention to the plans and sections which accompany the application to Parliament for the improvement of the river Severn, with Mr. Cubitt's report in explanation of the scheme and its advantages, and also Mr. Clegram's report to you, with other documents and papers on the subject.

In December, 1836, Mr. Rhodes, the engineer to the then proposed Severn Improvement Company, accompanied Mr. Cubitt and me on a view of the river. There had been a high flood ten days before, and at the time of our view the water was from eight to ten feet above the summer level. Ever since I received such recent instructions as I felt justified to act upon, the floods have been still higher, so that I have not had the opportunity of seeing the river in its short-water or summer state which would have been desirable; and my report must be taken, with allowances for this disadvantage, as to knowledge of facts and otherwise.

Mr. Cubitt's Plan.—Mr. Cubitt's plan is well described in his report. It differs from that of Mr. Rhodes in his plan first deposited, when a ship communication to Worcester was intended, in leaving out the weir and works Mr. Rhodes proposed near Gloucester; in placing the first weir, that near Upton, about a mile higher up the river than Mr. Rhodes at one time proposed, and about three miles lower than Mr. Rhodes's last proposal, as I understood it from himself*: in placing a lock and weir below Worcester, and below the entrance of the Birmingham and Worcester Canal, instead of above that entrance; in placing the uppermost lock, that nearest Stourport, in the river, and the weir in the new cut, the reverse of Mr. Rhodes's plan; in increasing the length of all locks above Worcester from 90 to 100 feet, and diminishing the width from 24 to 20 feet. I observe also that the works are now to be executed, not by a Company, but an Association, and if this word be, as respects the objects, synonymous with Trust or Commission, I think the change of character a decided improvement, for the idea of locking up the Severn in the hands of a joint stock company always appeared to me very objectionable.

Trade of the River Severn.—The River Severn, from its position in reference to the Bristol Channel, from the very great length for which it is navigable, from the numerous canals that connect with it, and which supply the wants, and take off the natural products and manufactures of several of the most densely inhabited and richest counties, and from the great extent of country of which it is the great drain, is in point of importance inferior to scarcely any river in the kingdom. Below Gloucester the river suddenly spreads out to a great width, and partakes more of the character of an estuary, consisting of sandbanks and shallow, shifting, tortuous channels, and a lift of tide that is scarcely perceptible at neaps.

Hence, in its natural state, the Severn was not, without great danger and delay, navigable for many miles below Gloucester, but for the smallest description of vessels; Bristol was, in fact, the port of Gloucester. The Gloucester and Berkeley Ship Canal, which was begun by individual subscriptions in 1794, and which, through want of funds, might, but for the liberal loans from the Commissioners for the Loan of Exchequer Bills for Public Works, have been a ruin at this time, was opened in 1827, and has removed the above evil as high as Gloucester. Ships of very heavy burthen, say 500 to 600 tons register tonnage, are now docked close to the city, and an impetus has been given to the trade of the town and of this portion of the kingdom. In this dock by far the greater part of the ascending and descending inland trade is transhipped into or from canal boats and barges—the remainder is conveyed in Trows, which load chiefly at Bristol, pass through the Gloucester Canal, and go up to Worcester, thirty miles, or to Stourport, which is twelve miles higher.

Proposed Improvements.—It is upon the portion of the river between Gloucester and Stourport, that the improvements are now proposed, and notwithstanding my limited knowledge, I feel justified in saying, that whether as respects navigation or drainage, this river has been most greviously neglected, that it is capable of improvements, and that it ought to be improved. At present we have a river of the importance I have named, upon portions of which the track-path (if it deserve the name) is covered with water, so as to be impassable whenever there is any flood. In short-water time, again, the shoals are such, in many places, some even below Worcester, that a canal boat of 24 tons burthen, and drawing under four feet, the great trade of the river, cannot make certain of getting over them, but is liable to considerable delay. These shoals are local, and appear to consist of material which might be removed, and being removed, and the width regulated, would not be likely to return, as is proved by the deeper water, above and below the shoals; but even this does not appear to have been attempted.

Expediency of Improving.—On the expediency of some improvement there ought not, therefore, as I think, to be any difference of opinion. The questions are, to what extent, in what manner, and how the trade is to be taxed to secure the repayment of the cost of the necessary works? for without good security, either the funds will not be obtained to do what is required, or the terms will be unfavourable, for which the trade will, in the end have to pay. The idea of paying any thing upon a hitherto free river may not be more agreeable than the payment of tolls upon turnpike roads; but if the expenditure be judicious, and the toll equitable, the traveller who pays has the greatest benefit.

Proposed Depth.—Mr. Clegram thinks the depth proposed by Mr. Cubitt greater than the vessels that now use the river require; and his observations on the particular nature of the trade are entitled to great attention. But it is also to be remembered, that the size and draught of a portion, at least, of the vessels, those that load in the river, are limited by the capability of the river; that half the number of Trows go up with half cargoes, caused, I presume, in part at least, through want of water; and that greater capability would probably give rise to vessels of greater burthen, which at present it would be imprudent to construct. Again, the facility of navigating vessels of less draught than the greatest depth, even canal boats, is increased by having a good depth of water. The floods also go off more rapidly; and thus both navigation and drainage are improved. It is to be remarked, also, that in fixing the level of the lock and weir, which cannot afterwards be increased, Mr. Cubitt is obliged at once to calculate on his ultimate minimum summer depth. Therefore, although the depth proposed by Mr. Cubitt may be too much to execute at first, I think that nothing particularly below Worcester, ought to be done which will prevent the depth he proposes, when there appear occasion and funds for it. The argument, that the upper lock of the Gloucester and Berkeley Canal has only four feet to four feet six inches in times of drought, is good to an extent only, and is a question of inconvenience against expense. A lock of greater size might, I presume, be made, should the trade justify such an expenditure.

Stourport to Worcester. Effect of Weirs.—I also think that, from the inclination of the river, and the nature of the channel, there is probably no better way of improving the navigation between Stourport and Worcester than by means of locks and dams. In saying this, I claim allowance for the limited extent of my information; and certainly, to dispense with the dams altogether, or even partially, would, if practicable, be desirable. Mr. Clegram's idea is that a canal from Worcester to Stourport is practicable, and would be preferable to dams.

Objection to Solid Weirs.—Thus far, and it is a great part of the way, I agree with Mr. Cubitt; but I cannot at all see how, if the dams or weirs are to be solid, as described, without flood-gates or even waste-boards, neither of which are named, they are not to prejudice the drainage, in place of improving it. If made very oblique across the stream, as proposed, their length will no doubt be increased; and with the same depth over the dams, the quantity passed over will be proportioned to the length. But the principal effect of lengthening the weirs will be to decrease the height of the water running over them, and not so much to increase the cubic quantity: for the quantity that reaches the weirs, or the depth at the weirs, is dependent on the direct cross-section (the width and depth) and the velocity above the weirs (that is, higher up the river), than where they are placed; and there

* I extract this from a note made at the time, but I am informed that Mr. Rhodes's plan (previously deposited) shows the weir in the lower situation.

is, I think, no doubt that placing solid dams at intervals across the stream, whether directly or obliquely, and from five to eleven feet above the present bottom of the river will diminish the velocity of that portion of the water which is below the level of the weirs, and near them, and of the whole descending column for a very considerable way up the river; and that in this length so interfered with, particularly near the weirs, first the water will be kept back, then a deposit will take place, which will diminish the depth, and therefore raise the surface of the water and increase the floods. The bed of the river will, in fact, be raised, unless kept down by constant dredging. But, even with dredging, the height of the surface of the water will be raised, independently of the bottom. When Mr. Cubitt says, "there will be a greater water-way on any cross-section at the weir after its erection than before," he either refers to length only, or to some particular depth over the weir at the time of some very extraordinary flood, because the sectional water-way can only be measured from the top of the weir, all under that part being, by the erection of the weir, taken from the area of the water-way. Without, I am sure the most remote intention, the position here stated is apt to mislead; and, independently of the above, I do not calculate on much good from the obliquity of the dams, unless the river be enlarged for a great length above them, so that the stream of the water may come at right angles nearly to the dam. Besides this, there can be no doubt that these permanent weirs will increase the difficulty, to say the least of any great future improvement to the drainage of the country above them. I do not mean to say that the dredging and deepening of other parts of the river will not diminish the effect of the obstruction, but the dams are so much higher than the shoals to be dredged, that I do not think they will by any means counteract the injurious effect, while the dredging without the solid dams would do as much good to drainage as to navigation.

Shropshire Navigation.—To the Shropshire navigation, also, from Ironbridge, the solid dams would be a great obstruction. The statement is, that these boats remain aground at Ironbridge during droughts, and until there is a fresh in the river, when they come down in fleets of twenty to thirty in number, making the passage of seventy miles to Gloucester in from eleven to sixteen hours: that there they unload their cargoes with the greatest dispatch, th t they may get up again before the water has gone down. I cannot see how, to this description of trade very serious delay by solid weirs is to be prevented, when each boat is to be locked down and up through five locks, independently of the risk of being carried over the weir when the velocity is considerable.

Can, then, the present delay during droughts be remedied, and yet these evils prevented? I think they can, even presuming dams to be necessary, by forming them not as solid weirs, but as opening gates, to be shut in times of drought only, but to remain open to the bottom of the river in times of flood, and whensoever there is abundance of water for navigation, so that both the flood waters and the trade may pass through the gates without interruption or delay by lockage. These gates need not be the whole width of the river, but the sides only, the space between the banks and the gates, should be furnished with sluice or draw-doors, to open so as to pass the floods, and to this there could not, as it appears to me, be any reasonable objection, unless the expense be such as to exceed the benefit, which when the importance of the navigation is considered, would not, I apprehend, be the case: but if it should be so, I still think that much good might be done by dredging the shoals, and contracting the width, where the too great width is the cause of the formation of the shoals, which, unless where the material is hard, will probably be found to be the case. In most cases, as appears upon the sections, the material of the shoals is too hard to be acted upon by the floods, and then the shoals, once dredged away, will not be likely to form again. Should not the experiment be made? It would be useful, even if dams were constructed afterwards. Undoubtedly the floods of the Severn, if more confined within their channel, would keep a large water-way open.

Worcester to Gloucester.—What I have yet said as to dams is confined to the part of the river above Worcester. Below that city the river assumes a different character, the depth is greater, and the quantity of low land which is liable to be flooded more extended. The entrance of the Birmingham and Worcester Canal is below Worcester: and I have been informed that two-thirds of the tonnage that goes above Gloucester does not go higher than Worcester. Hence, therefore, both as respects drainage and trade, an open unobstructed river between Gloucester and Worcester becomes much more important than above Worcester; the expense of a dam also, such as I have described, much greater, and I hope, and indeed think, it may be dispensed with. Mr. Rhodes designed his ship lock and weir at Saxon's Lode, 17½ miles above Gloucester, or one mile below Upton Ham, where Mr. Cubitt now proposes it: but, in consideration of interfering with the drainage of the district, he was induced, in his subsequent plan, as I understood him to say, to remove it up to Cleve's Lode, 23½ miles above Gloucester, or 5 miles above Mr. Cubitt's present site. Now, Worcester is only 6 miles above Cleve's Lode, or 11 miles above Upton Ham. In this length there is more than six feet in depth, excepting at the shoals, which do not appear more numerous than lower down the river, where the depth is proposed to be obtained by dredging. The average fall in the river, from Upton Ham to Worcester, being only 4½ inches per mile, I think there is little reason to apprehend a want of depth at the upper end, after such a deepening and regulating as will be required. If the excavated material were applied to raise the banks, the land would be less liable to be flooded, and the scour being confined in the channel of the river, would increase the depth. It will be understood that my objection as respects floods is confined to the space above the first weir—all below the weir will be improved by Mr. Cubitt's plan.

Thus, also, the objection made, reasonably as I think, to the inadequacy of one lock to pass the trade, would be obviated, as so large a proportion would stop at Worcester, short of the first lock.

Clyde.—The Severn here is in some respects different from the Clyde, but there is a similarity, and the good effects of not adopting Smeaton's plan of damming the river so as to secure a promised depth of 4 ft. 6 in. at Glasgow, at high-water neap tides, even after an act had been obtained for it, but of deepening and regulating, by which there is now 13 feet, has made that city what it now is, and has much increased the value of the low lands, which were more liable to be flooded than they now are. One would expect the Worcester, of all parties concerned, to be least the advocates for dams and locks between Gloucester, and their city, to limit the capability of their trade in the size and number of vessels; until, at least, it be proved that they cannot be dispensed with; and, whenever this is the case, the importance of having the gates constructed as I have described, to be shut in short-water times only, is greater here, on account of the extent of flooded land, than above Worcester. Whether referring to the extent of the trade, to the delay which will be consequent upon passing every thing through a lock, or to the drainage of the country, I think solid weirs objectionable; and if this be the case now, it will be much more so after the river is improved, if an increase of trade, with the introduction of steam-tugs, be the consequence, as is probable. A tug would take a whole fleet of boats or barges behind her. The Severn is at present far behind in the power applied to track the boats, being partly horse and partly human labour; and I decidedly think the solid weir will tend to perpetuate the slow system. Until steam be general, the towing paths ought to be raised and improved. They appear to lie in the hands of two joint stock companies, and the bill does not attempt to interfere with them, excepting at the proposed new cuts; but perhaps a great reform has taken place in their condition since 1836. The towing paths on the Clyde are entirely abandoned, every thing being done by steam-boats or steam-tugs.

Works above Worcester.—The dams above Worcester, as I propose them, would be more expensive than Mr. Cubitt's. I think it probable, supposing dams to be indispensable, that a smaller number might suffice, for the following reasons.—The average present summer inclination in the surface of the river above Worcester is 21½ inches per mile. Mr. Cubitt appears to suppose that, after the construction of the weirs this will be reduced to little more than one inch per mile, which I think very much under the mark, and therefore that the pen of the weirs will reach very much higher than he supposes, thus allowing sufficient depth for a greater length between the locks, which will be desirable. And here I may say, that I do not agree with Mr. Cubitt, when he states that, "if all below the entrance of the Gloucester and Berkeley Canal be left untouched, it is evident that no alteration will be made in the height of the water up to the first weir." On the contrary, every obstruction or shoal that is dredged in the whole length, tends to lower the water in the part of the river above it. The section of the stream being increased by the removal of the shoal, a less velocity, and therefore less slope in the surface of the water, is required for passing the descending water, and hence a sinking of the surface increasing upwards. This must be compensated for by greater dredging toward the upper end, to give the required depth. There ought not to be a difference of opinion on this point, and therefore either the expression does not convey Mr. Cubitt's meaning, or I have misunderstood it.

JAMES WALKER.

23, *Great George Street, Westminster,*
March, 1841.

THE TOMB OF THE GREAT CAPTAIN.

(From Dr. James Macauley Foreign Secretary of the Botanical Society, Edinburgh.)

Of the many historical monuments which are met with in the ancient city of Granada, one of the most interesting is the tomb of Gonsalvo of Cordova, the Great Captain. This tomb would in any other place have been a celebrated point of classic pilgrimage; but in a city containing the Alhambra and so many glorious remains of the Moslem empire in Europe, other objects of historic interest have been almost wholly overlooked by travellers. My attention was called to it by a note in my copy of Don Quixote, where it is said that "Gonsalvo toward the close of his life founded a monastery in the neighbourhood of Granada, and was buried in its church. His epitaph, which still remains there, is simple and grand; GONSALVUS FERDINANDUS A CORDOBA, DUX MAGNUS HISPANIARUM, GALLORUM ET TURCORUM TERROR." On making inquiry, I found that the tomb was not in the monastery he had founded, which was that of Cartuja, but in the chapel of the convent of San Geronimo. Of this magnificent edifice, the Nuncio Aldobrandini, while conversing in the Alhambra with Philip V., said that "he had seen nothing in Italy more great in architecture." Separating from this what may be due to the flattering courtesy of a foreigner, there is yet in the remark a good eulogium of the work, and a high testimony to the merit of the architect, the famous Diego de Siloe. He it was who also built the cathedral of Granada, which in magnificence and taste exceeds all the cathedrals of Spain, and may be ranked with the finest edifices in Europe. He spent thirty years in the construction of the convent of San Geronimo; a truly noble piece of architecture, whether we regard the grandeur of the design or the beauty of the details, and a work worthy of the high name which Diego de Siloe bears in the history of art in Spain. The place is at present used as a barrack for soldiers. The remains of Gonsalvo are in a vault in front of the altar in the chapel. This part of the building is in a most desolate and dismantled state, every vestige of decoration and ornament having been destroyed, and the very woodwork of the chapel having been torn down for firewood. What a contrast from the former condition of the place, when historians relate that the shrine was famous for its riches and splendour, and the walls were covered with trophies taken from the enemies of Spain, among which were two hundred banners and two royal standards taken by the Great Captain! The short epitaph formerly referred to, I was unable to find; but upon one of the flat stones on the floor near the altar I observed the following inscription:—

Gonzali Fernandez de Cordobâ,
qui propria virtute
Magni Ducis nomen
proprium sibi fecit,
Ossa,
perpetuæ tandem luci restituenda,
huic interea loculo condita sunt,
Gloriâ minime consepultâ.

The epitaph appeared to me to be happily expressed, and reminded me of the brief and fine eulogium of Cervantes, introduced at the place where the innkeeper brings to the curate and barber his library of three books, two of which were condemned to the flames, but the third was worthy of immortal honour, being the history of Gonzalvo Ferdinand, "el qual por sus muchas y grandes hazañas mereció ser llamado de todo el mundo Gran Capitan, renombre famoso y claro, y dél solo merecido." While our party were in the chapel, a number of the soldiers from the convent had followed us from curiosity, and wondered what we found to interest us in its bare and desolate aspect. In passing through Spain, the traveller at every step meets traces of its former glory and splendour, and cannot help contrasting these with the present degraded state of the country and people. The contrast came with new force to me while in the chapel of San Geronimo; recalling the brave veterans of the wars of Naples and Flanders, then the finest soldiers in Europe, and comparing them with the wretched troops of modern Spain, specimens of which were now gaping and jesting over the remains of the Great Captain.

PORTER AND CO'S PATENT ANCHORS.

One of the most interesting experiments, and one which cannot fail to prove of immense advantage to the navy, and the merchant service, took place on Monday in the presence of Captain Phipps Hornby, C.B., superintendent of Her Majesty's Dockyard, Woolwich, and a number of nautical gentlemen. One of Porter and Co.'s patent anchors having been previously placed on the testing frame, an immense power was applied by an hydraulic machine invented by Bramah and Son, and the anchor weighing 5 cwt. 2 qrs. 24 lb., which would have been considered safe according to the adopted test of $8\frac{3}{4}$ tons, actually sustained additional strains until it reached $20\frac{1}{3}$ tons before it gave way under the application of that immense power—nearly $2\frac{1}{2}$ times greater than would ever be required under ordinary circumstances. A second anchor, weighing 5 cwt., was afterwards placed on the testing frame, and the power having been applied, it sustained a strain of $21\frac{1}{2}$ tons, given by jerks, before it gave way, although it would have been considered perfectly safe if it had stood $8\frac{1}{4}$ tons. There was another anchor by the same patentee on the spot, of still larger dimensions, but the experiments with the other two were so satisfactory that it was not found necessary to prove its capabilities. It appears strange, and yet it is evidently the fact, that the more simple the construction of any article is, there is the greater certainty of its success. The principal difference betwixt this anchor of Porter and Co., and those at present in use, is a projection on the outside of the fluke, which enables it to catch hold of the most difficult ground, and ensures its obtaining a firm hold and double power by the upper fluke descending on the shank, and acting as a fulcrum in the most effectual manner. By the kindness of Captain Denham, of the Marine Surveyor's department, we have been enabled to give the following details of the advantages of this anchor.—"It is almost impossible to foul it. It bites quickly into the most stubborn ground. It holds on the shortest stay peak. It cannot well lodge on its stock-end. It presents no upper fluke to injure the vessel herself or others in shoal water. It cannot injure vessels' bows when hanging cock-bill, as merchant vessels find a convenient practice. It is not so likely to break off an arm or part in the shank as anchors with fixed flukes do, because the construction of these arms can be of continuous rod-iron, and the leverage is so much nearer the ring, owing to the pea of the upper ring closing upon the shank. It is a most convenient anchor for stowing on board, on a voyage, as the flukes can be easily separated, and passed into the hold; it can as easily be transported by two boats, when one would be distressed with the whole weight. Several of the officers who witnessed the experiments stated their intention of applying to the Admiralty for anchors on this construction, as they were so satisfied of their advantages."—*Times*.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Jan. 12.—Joshua Field, V.P., in the Chair.

"*Remarks on the comparative advantages of long and short Connecting Rods, and long and short stroke Engines.*" By John Seaward, M. Inst. C. E.

The author commences the communication with a description of the engines first placed on board the Steam Frigate, "The Gorgon."

The engines are constructed on the principle of "direct action," that is, the power is communicated directly from the piston to the crank, without the intervention of side levers, and the other parts usually employed in the construction of marine engines; this is one leading feature. Another is, that the main shafts are placed directly over the centre of the cylinder; and as these shafts are carried by strong frames and wrought iron columns standing upon the cylinders, the force of the engines is confined between the cylinders and the frame, and thus isolated from the sides of the vessel. Other advantages accruing from this construction are, in the author's opinion, a saving of space and weight, the absence of the vibration resulting from the action of the side levers, and a more efficient application of motive power, arising from the simplicity of the construction and diminution of friction.

Two main objections have been urged against this system—1st, that the shortness of the connecting rod causes a loss of effect; and 2nd, that the shortness of the stroke is a disadvantageous application of the power of steam.

The arguments in support of these objections are combated at considerable length. With reference to the alleged loss of power by the use of the short connecting rod, it is argued, that as no arrangement of long or short rods or levers could create power; so no arrangement of similar parts could be productive of loss of power. A geometrical investigation of the force actually exerted on the crank by long and short connecting rods is then given, and the result deduced is, that by adding together the whole of the force exerted by the two kinds of connecting rods respectively, during one entire rotation, they both give the same actual amount; thus proving, that no loss arises from the use of the short connecting rod.

It is admitted, that there is some increase of friction on the journals of the connecting rod joints, but this occurs only at the extreme angles; some allowance is also to be made for the increased angular motion about the lower joints of the rod, but they are not collectively of sufficient importance to be considered as any objection in practice.

The calculations given are under the approval of Professor Airy, who thus expresses himself:—"The *greatest* force of the 'Gorgon' engines (when both cranks are below the horizontal line) is *greater* than the *greatest* force with common engines, but the *least* force is not less than the *least* force with common engines."

The whole power, in a complete revolution of the crank, is the same in both.

That a long stroke engine, under certain circumstances, may be more advantageously employed than a short one, is admitted; but considering the steam engine *per se*, it is argued, that the latter possesses no advantage over the former.

In two engines of equal power, equally well constructed, the length of the stroke being respectively eight feet and four feet, the cylinder of the latter having double the area of that of the former, making the same number of revolutions per minute, and having the steam passages and valves of the same area, it is clear, that the mechanical action of the steam must be identical, because the same volume of steam will produce an equal mechanical effect, whether it be introduced into a long narrow cylinder, or into a short wide one; setting aside the effect of working expansively, which, however, is not at all affected by the shortening of the cylinder: for it is just as practicable to shut off the steam at one-half, one-third, or one-fourth of the stroke of a short cylinder as of a long one.

The most essential differences between these two engines must be in the relative amount of friction, and of radiation of heat from the cylinders and passages.

In a well made engine four-fifths of the friction is due to the packings of the piston, air-pump bucket, and stuffing boxes, and about one-fifth to the gudgeons, crank pin, and other moving parts. The friction of the piston packing is as the circumference multiplied into the space through which the piston travels, and into the depth of the packing; therefore in a cylinder 30 inches diameter, 8 feet long, the friction of the packing will be as 24, while in a cylinder of 42·4 inches in diameter, 4 feet long, it will be only as 17.

The same train of reasoning is extended to the other moving parts, and shows that if the total friction in the short stroke be 100, that of the long stroke engine will be 123.

The radiation of heat from the cylinders will be as the relative areas of surface, which is less in the short stroke than in the long.

An examination of the comparative friction of the moving parts of steam engines is entered into; rules for computing, and tabular results are given; and the author concludes by observing, that although the relative dimensions selected as examples are uncommon in England, they are not so in America, where pistons of marine engines frequently travel at the rate of three hundred to four hundred feet per minute. It is contended that the speed of the piston is immaterial, provided the engine be well proportioned to the speed; at the same time bearing in mind that a slow speed will be more favourable for the easy and pleasant working of the engine, and for durability. The paramount objects to be aimed at in the construction of marine engines are, the greatest saving of fuel, space, and weight, and the durability of the machine; and as the question is not whether the stroke should be eight feet or four feet, but relates to a diminution from the present length of seven feet to probably six feet, it is contended that the form of the "Gorgon" engines offers considerable advantages in the points treated of, independently of the positive diminution of weight and space, which forms no part of the immediate inquiry.

A drawing of the "Gorgon" engines accompanied the communication.

"*Description of a Thirty-Ton Crane, erected on the Quay of Earl Grey's Dock, Dundee Harbour.*" By James Leslie, M. Inst. C.E.

The Crane is placed on a stone platform sixteen feet square, raised six feet above the level of the Quay, with its centre seven feet back from the Dock face; and as the sweep or radius is thirty-five feet to the perpendicular of the jib-sheave, the load is suspended twenty-eight or twenty-nine feet over the Dock (as the double or single purchase sheave is used). The height of the sheave above the level of the Quay is forty feet.

Instead of the framing revolving about a fixed post, as in the usual mode of construction, the post itself is connected with the framing, and turns with it, so that the strain may be always in the direction of the greatest strength.

To avoid the extra dimensions of the castings for the post, if it had been composed entirely of cast iron, and for facility in the construction, the parts of cast and wrought iron are so combined that the "push" is thrown upon the cast-iron abutting piece which is placed in front, while the back part, consisting of wrought-iron tension bars, bears the "pull." The two rings on the post are turned on the face and edges, and being bolted together form a fair surface for the friction rollers, while the back forms a rest for the tension bars.

These back tension bars are three inches wide by two and a half inches thick, each, forming an aggregate section of forty-five inches. They were all proved in the bent form in which they are used, by making fast the ends of each bar to cross heads held apart by two logs, and suspending a load of twenty-four tons from the elbow formed by the bend in the bar; this was calculated to be equivalent to a longitudinal strain of ninety tons. There are also two side tension bars, two inches square each, firmly sunk in the cast-iron block, and bolted to the top of the framing.

The post revolves within a cast-iron cylinder twenty-seven feet deep, five feet three inches diameter, with turned and bored water-tight joints. The whole is surrounded with masonry, bound together by strong iron hoops and diagonal tie bars passing through the fixed ring.

The jib is of oak two feet diameter in the middle, and twenty-one inches at the ends; the two wrought-iron jib stays are each three and a half inches diameter; the chain is of $1\frac{1}{4}$ inch iron. Eight men easily lift a weight of thirty tons, and by means of the horizontal wheel-work one man can turn it round.

The total weight of the castings, wrought-iron bars, chain, and brasses, is about fifty-nine tons.

The crane was made and erected by Mr. Borrie, of Dundee, from the designs and under the direction of the author.

The communication is accompanied by two elaborate working drawings, on a large scale, with details of the mode of construction.

"*A Refrigerator, or Machine for cooling Brewer's Wort.*" By Robert Davison, M. Inst. C.E.

The machine described in this paper was constructed for the purpose of ascertaining the most expeditious process for cooling wort, without deteriorating the quality of the liquor.

Two kinds of preliminary experiments were made, viz.—

1st. As to the rate of cooling by simple exposure to the atmosphere in the ordinary shallow vessel, having a superficial area of 420 square inches, the liquor being $1\frac{1}{2}$ inch deep.

2nd. As to the rate of cooling, under similar circumstances, with the assistance of air mechanically driven over the surface of the liquor at different velocities.

In both cases the loss by evaporation was noted.

The numerons experiments are detailed in a tabular form, whence may be selected three series, which will give the average relative results.

Wort cooled.	Naturally under Atmospheric Temperature, 75°.		1. By Blast at the rate of 32 miles per hour. Temp. 65		2. Blast at the rate of 47 miles per hour. Temp. 65		3. Blast at the rate of 57 miles per hour. Temp. 65		4. Blast at the rate of $84\frac{1}{2}$ miles per hour. Temp. 65°	
	min.	sec.	min.	sec.	min.	sec.	min.	sec	min.	sec.
From 160 to 150	3	33	2	..	1	30	..	41	..	25
From 130 to 120	8	30	1	10	2	4	1	6	1	7
From 100 to 90°	22	5	6	30	3	41	3	18	2	3

A higher velocity than $84\frac{1}{2}$ miles per hour was found prejudicial, as a portion of the wort was driven over the side of the vessel.

The relative loss by evaporation was

By natural cooling .... 1·40
By blast, at 32 miles per hour .... 1·45
Ditto at 57 miles .... 1·47

Hence it would appear, that the evaporation effected was about the same in all the experiments; and the rate of refrigeration nearly in the direct ratio of the velocity of blast.

These results induced the author to try other applications of the blast, by causing the wort to flow down over a series of slightly inclined planes, being exposed at the same time to a powerful ascending current of air from a fan blower. The introduction of air directly into the wort was, however, found to raise a froth or "fob," which would affect the soundness of the beer. Several other methods were tried, and at length the machine now described was constructed.

The wort is pumped up at a slow and regulated speed into a recipient at the top of the machine, divides into a series of thin films or streams, and trickles down the inside of a number of thin metallic tubes, set vertically, with their upper extremities quite level. Up these tubes is forced a current of air at any required velocity, which, meeting the descending wort, cools it inside, whilst a constant change of cold water takes place around the exterior of the tubes. The wort, on leaving the vertical tubes, is received into a second refrigerator, containing a number of horizontal pipes through which cold water flows. By this process the wort is cooled without producing any prejudicial effect upon its quality, and with a rapidity (as shown by the table) which would be extremely advantageous under certain circumstances.

This communication was accompanied by two drawings of the Refrigerator, and illustrated by a working model with which the experiments had been made.

"*An Account of the Repairs and Alterations made in the Structure of the Menai Bridge, in consequence of the damage it received during the gale of January 7, 1839.*" By T. J. Maude, Grad. Inst. C.E.

The roadway of the Menai Bridge having been seriously injured by the storm of January 7, 1839, it was deemed expedient to renew entirely the suspended platform: and at the same time to carry into effect certain alterations in the construction, suggested by constant observation of the working of the Bridge during thirteen years, as well as its condition after the storm.

In the original structure, each long roadway bar was fixed at three points to the vertical suspending rods. Motion being chiefly communicated to the roadway by the vibration of the windward chain, one end of the long bar suspended from it was lifted up, whilst the other two points of suspension remained nearly stationary. The bar thus became a lever with its fulcrum at the middle point of attachment, and at that weakest part it invariably broke. In order to remedy this defect, an augmented depth of half an inch has been given to the new roadway bars, with an additional enlargement round the eyes for attachment to the suspension rods, and each bar is hung from two points only, permitting it to play when the Bridge is subjected to motion.

The same vibratory action occasioned frequent fracture of the suspending rods close to the surface of the platform; to such an extent, that during the storm a great portion of the platform was entirely torn from its fastenings on one side, and hung down flapping in the gale supported merely by one line of rods. To remedy this, a joint has been introduced in each rod just above the surface of the platform, so as to allow the suspension rods free action, and permit a motion in either of the carriage-ways or the footpath independently of each other. The dimensions of the short suspension rods have been increased to one inch and a quarter square, whilst the remainder of the rods are only one inch square. The effects of the lateral and undulating motions are provided against by the direction of the working of the joints, one of them being in the line of the roadway bar, and the other at right angles to it.

Additional rigidity has been given to the platform by applying a course of three-inch planking laid transversely throughout its entire length, and bolted through each plank at intervals of two feet six inches apart, the oak beams originally placed beneath the platform having been entirely removed.

For the purpose of checking longitudinal undulation, two lines of beams, formed of two pieces of Baltic fir, each 40 feet long, 13 inches deep, and $4\frac{1}{2}$ inches thick, are framed to the trussed bearers, and bolted up beneath each carriage-way the entire length of the platform: at the same time an increased depth has been given to the wheel guides, which are also bolted through to to the planking. The total depth given by these strengthening beams and guides, is three feet four inches, while in the original structure it was one foot four inches.

The weight of the additional timber and iron-work introduced into the bridge, is about 130 tons. The whole of the timber has been Kyanized, and each coat of planking covered with Archangel tar; the felt has been discarded, as it does not appear to have answered its intended objects in the original structure.

In these alterations (which were designed by Mr. Provis, M. Inst. C.E.; one main object, which was never lost sight of, was to preserve that simplicity of construction which is so striking a feature in the original design; and should any future derangements occur, any part can be repaired or replaced without disturbing the rest of the structure.

This communication was illustrated by a drawing of the original platform, and of the alterations described in the Paper.

February 2.—The President in the Chair.

"*On a Method of setting out involute Teeth of Wheels, so that any two wheels of the same or of different diameters will work truly together, whether the teeth bottom or only just touch each other.*" By Edward Cowper.

The rule is briefly this:—

Point off the teeth on the pitch circle in the usual manner; then take the smallest wheel of the set, and having decided upon the depth of the proposed tooth, describe a circle (called the Evolute) touching the bottom of the tooth.

On all the other wheels describe evolute circles, bearing the same proportion to *their* respective pitch circles, which the evolute circle of the smallest wheel bears to *its* pitch circle—thus, if in the smallest wheel the evolute circle is $\frac{1}{12}$th less than the pitch circle, let all the other evolutes be $\frac{1}{12}$th less than *their* pitch circles. From these evolute circles as bases, describe the involute curves of the teeth, making the curves pass through the points set out for the teeth, upon the pitch line.

"*An Account of some Experiments to determine the force necessary to punch holes through plates of wrought iron and copper.*" By Joseph Colthurst.

These experiments were performed with a cast-iron lever, 11 feet long, multiplying the strain ten times, with a screw adjustment at the head, and a counterpoise.

The sheets of iron and copper which were experimented upon were placed between two perforated steel plates, and the punch, the nipple of which was perfectly flat on the face, being inserted into a hole in the upper plate, was driven through by the pressure of the lever.

The average results of the several experiments (which are given in a detailed tabular form) show that

The power required to force a punch	Inch diam. 0·50	Through an iron plate	Inch thick. 0·08	is 6025 ℔.
Ditto	0·50	Ditto	0·17	is 11,950 ℔.
Ditto	0·50	Ditto	0·24	is 17,100 ℔.
Ditto	0·50	Through a copper plate	0·08	is 3983 ℔.
Ditto	0·50	Ditto	0·17	is 7883 ℔.

Hence it is evident, that the force necessary to punch holes of different diameters through metal of various thicknesses, is directly as the diameter of the holes and the thickness of the metal.

A simple rule for determining the force required for punching, may be thus deduced.

Taking one inch diameter, and one inch in thickness, as the units of calculation, it is shown that 150,000 is the constant number for wrought-iron plates, and 96,000 for copper plates.

Multiply the constant number by the given diameter in inches, and by the thickness in inches; the product is the pressure in pounds, which will be required to punch a hole of a given diameter, through a plate of a given thickness.

It was observed, that duration of pressure lessened considerably the ultimate force necessary to punch through metal, and that the use of oil on the punch reduced the pressure about eight per cent.

A drawing of the experimental lever and apparatus accompanied the communication.

"*Geological Sections of Railway Cuttings.*" By Mr. Sopwith.

Mr. Sopwith called the attention of the meeting to the valuable Geological Sections presented by the railway cuttings, and other engineering works now in progress; this was particularly the case on the North Midland Railway, where the crops of the various seams of coal, with the interposing strata, were displayed in the clearest manner, developing the geological structure of the country which the railway traverses. Numerous similar instances induced the British Association to devote a sum of 200*l.* (which it was believed would be increased from other sources), for obtaining authentic records of such sections, before the action of the atmosphere or the progress of vegetation should have obliterated the instructive pages of geology, which the engineer had opened to view.

The Committee of the British Association, especially charged with this subject, were desirous of bringing it before the Institution of Civil Engineers, for the double purpose of receiving from its Members those suggestions which they are so competent to give, and of obtaining from them that powerful aid and co-operation which the practical nature of their engagements so essentially enabled them to afford; it was accordingly suggested, that the Council should receive from Graduates, descriptive papers and measured delineations of sections, as their communications previously to their Election. Much assistance might thus be rendered, and the contributions, after having been read at the Institution, might be added to the general series preserved in the Museum of Economic Geology, which under its present able direction is becoming daily more interesting both to the engineer and the geologist.

Mr. Sopwith exhibited a specimen of a blank chart, prepared by Mr. Phillips, of York, for the committee. It consisted of a sheet engraved in squares, on a scale of 40 feet to an inch, containing a space equivalent to 800 feet in length, and 600 feet in height, upon which it was proposed to delineate the sections in their true vertical and horizontal proportions; the base line representing either the level of the sea at half tide, or the datum line of the railway, as might be most convenient. There would remain in every case a large portion of the sheet unoccupied by the section, and upon this it was proposed to exhibit, on a magnified scale, the details of the section; the fossils and other organic remains might also be shown, as the divisions of the squares would enable the sketches to be made of any dimensions in correct proportions. An example of these charts had been prepared by Mr. Phillips, giving a section of a deep cutting on a railway, the enlarged portion exhibiting the details of the strata at two particularly interesting points, as also of the specimens of sigillaria, stigmaria, &c. in that formation.*

Geological Models.—Mr. Sopwith also laid before the meeting a set of models, which were intended as hand specimens for the purpose of familiarly explaining faults, slips, or dislocations of the strata, and other geological phenomena, which could not be clearly demonstrated without such assistance. One of these models represented the horizontal deposition of stratified rocks, and the subsequent removal or degradation of such rocks, forming valleys of denudation. Another, by the displacement of the lower rocks, exhibited the formation of a slip dyke, or fault, which was the "lode or vein" of the mineral miner, and the "fault" or "trouble" of the collier, as these interruptions of the continuity of the bed of coal were generally termed. Another model showed a succession of slip dykes disturbing the stratification, so as to present the appearance of a great abundance of coal at the surface by the "cropping out" or "bassetting" of a number of seams or beds of coal, whereas in reality there was only a repetition of the same beds. By examining the base of the model, and also by opening it on an oblique plane nearly parallel with, and at a short distance below, the surface, it would be found that there was no coal at all. A fourth model exhibited the conditions under which some of the largest collieries in the kingdom are worked, namely, that the seams of coal do not appear on the surface, but on opening the model a vertical section is exhibited, and the several beds are shown, disturbed as in the former case by faults or dislocations, but which have not the effect of bringing the coal to the surface.

It has always been difficult to demonstrate without the aid of models the apparent form of strata, as effected by the contour of the country; sometimes the rocks form a V, pointing up the valley, and sometimes in the opposite direction. General observers and even practical miners were apt to conclude, that this different direction of the point of the V, indicated a different direction of the strata, but the models showed that in both cases the direction of the strata was the same; that in both cases the rocks were inclined in the same direction as the valley, the only difference being that in one case the rocks form a greater, and in the other a less, angle with the horizon than the bottom of the valley. The other models exhibited the "up-cast" and "down-cast" which occur in coal mining, and intersections of veins of different ages, &c. Most of the specimens shown presented details of the carboniferous formation, but models of this description were of course applicable to every formation and to every kind of geological structure. Mr. Sopwith brought forward this subject in hopes that eventually a close union and active co-operation might be established between the leading scientific institutions of this country, and more especially that the Geological Society and the Institution of Civil Engineers would unite in promoting the progress and improvement of geology and engineering.

February 9.—The President in the Chair.

The following were balloted for and elected: Sir Charles Baird, as a Member; Samuel Beazley, William Gossage, John Hughes, John Howkins, and Charles Schafaeutl, M.D., as Associates.

"*Upon the Application and Use of Auxiliary Steam Power, for the purpose of shortening the time occupied by Sailing Ships upon distant voyages.*" By Samuel Seaward, M. Inst. C.E.

But few years have elapsed since the possibility of propelling vessels by the power of steam was treated as a chimera; and although the practicability of its application for short voyages has been successfully demonstrated by the numerous vessels plying between this country and the Continent, it is but of very recent date that its employment for long sea voyages has been adopted. The weight of the powerful machinery and the fuel, and the consequent loss of space for cargo, together with many other circumstances attendant on the present construction of steam vessels, induced the author (who received the education of a seaman, and has since had extensive practice as an engineer) to believe that a more efficient mode of employing steam power for long sea voyages might be adopted.

Notwithstanding the great improvements which have taken place in the construction of steam vessels, and their machinery, it would appear that the duration of the voyage ought not to exceed twenty days, after which time a fresh supply of fuel becomes necessary; hence, steam has rarely been adopted for very long voyages. The reason of this limit to the duration of the voyage of a steam vessel, as at present equipped, is that an increase of power does not produce a corresponding increase of speed, while the weight of the machinery increases in proportion to the power employed, and in some cases exceeds it; for instance, small engines, with the water in the boilers, generally weigh about one ton per horse power, while in some large engines the ratio is nearly twenty-five cwt. per horse power.

A quadruple increase of power will not produce double the original velocity in a steam ship, although, in theory, such is assumed to be the case; for as the weight is more than doubled, the immersed sectional area becomes greater, and a still further increase of power is necessary. It has been shown by experience, that if a vessel with a given power is propelled through the water

* Specimens of the prepared sections and blank charts may be obtained from Mr. Delabeche or Mr. Jordan, at the Museum of Economic Geology, Craig's Court, Charing Cross, or from the Secretary of the Institution of Civil Engineers.

at the rate of eight miles per hour, her speed cannot be doubled, even though the power be multiplied twelve times, and the entire hold of the vessel occupied as an engine room.

The weight of fuel is also in direct proportion to the size of the engines; so that taking, for example, two vessels of two hundred and of four hundred horses power respectively—that of the higher power will have to carry nearly double the weight both of fuel and of engines, and it is still questionable whether the increased force will propel the one ship more than 1½ mile per hour faster than the other.

The space occupied by the engines and fuel in the most valuable part of the ship, is also an important consideration: neither the "President" nor "British Queen" steamer, although of two thousand tons measurement, is capable of carrying more than five hundred tons of cargo when the fuel is on board.

The author then examines the question of employing too much power in a steam vessel, and refers to the "Liverpool," as an instance that such may be the fact. It appears that with the original dimensions of thirty feet ten inches beam, and engine power of four hundred and fifty horses, being a proportion of power to tonnage of about 1 to 2¼, the vessel was immersed four feet beyond the calculated water line, and a decided failure was the natural consequence; but when the breadth of beam was increased to thirty-seven feet, augmenting the capacity four hundred tons, and giving the proportion of one horse power to 3¾ tons burthen, the performance of the engine and the speed of the vessel were both materially improved.

The "Gem," Gravesend steamer, one hundred and forty-five feet long, by nineteen feet beam, had two engines of fifty horses power each; the speed was insufficient, being only twelve and a half miles through the water; but when the same engines were placed in the "Ruby," which was one hundred and fifty feet long, and nineteen feet nine inches beam, the velocity of the latter vessel was thirteen and a half miles per hour. A pair of engines, of forty-five horses power each, were then placed in the "Gem," without altering the vessel, and in consequence of the diminished weight and draught of water, her speed then nearly equalled that of the "Ruby."

The author does not condemn the application of considerable power for vessels, provided it can be employed without materially increasing the weight and the area of the immersed midship section. It appears that the length of a steam voyage, to be profitable, is at present limited to twenty days for the largest class of steamers; that we have about thirty others which can approach twelve days, while the majority cannot employ steam beyond eight days successively, without a fresh supply of fuel. It is evident, therefore, that more efficient means must be adopted for the general wants of commerce in our extended intercourse with the East and West Indies, the Pacific, Mexico, Brazil, Australia, and all the distant colonies, which now demand rapid communication with England.

The author refers to a pamphlet, published by him in 1827, entitled, "Observations on the possibility of successfully employing Steam Power in navigating Ships between this country and the East Indies by the Cape of Good Hope." He therein proposed that large square-rigged ships, of fifteen hundred to eighteen hundred tons measurement, should be fully equipped and constructed, so as to sail ten or eleven miles per hour with a fair wind; that they should carry engines of small power, to assist the sails in light winds, propel them at a moderate speed during calms, work into and out of harbour, &c., and thus shorten those portions of the voyage wherein so much time was usually lost.

To all well-built good-sailing vessels, of four hundred tons and upwards, "auxiliary steam" is applicable. A steam engine of the necessary power can without inconvenience be placed in such vessels, either on or between decks, so as propel a ship at the rate of four to five nautical miles per hour in a calm, and for this speed a proportion of one horse power to twenty-five tons is amply sufficient. The practicability of applying this system to East Indiamen and other similar vessels is then examined at length, and it is shown that the ordinary speed of these ships under sail is, before the wind, eleven to twelve miles per hour, and in a gale thirteen to fourteen miles per hour, which is greater by two or three miles per hour than that of any ordinary steam vessel when under sail, on account of the latter being impeded by the wheels trailing in the water, and the slightness of their masts, spars, and rigging. The auxiliary steam power might, therefore, be efficiently applied, either by using it alone, or in conjunction with the sails, so as to keep up a uniform speed, by which a great saving of time could be effected in a long voyage.

The conditions of sailing and steaming voyages to India, with the influence of the trade-winds, are then examined, and the author proceeds to detail the experiments made by him, on board the "Vernon" Indiaman, which was the first sailing vessel that actually made a voyage out and home with "auxiliary steam."

The "Vernon," built in 1839, by the owner, Mr. Green, was one thousand tons burthen; the sailing speed was about twelve to thirteen miles per hour in a fresh gale, and being from her frigate build well calculated for the experiment, it was determined to equip her with a condensing engine of thirty horses power, placed midships on the main deck, between the fore and main hatchways; the space occupied being twenty-four feet long by ten wide. The weight of the machinery was twenty-five tons, and it was so arranged that the motion was communicated direct from the piston cross-head by two side rods to the crank on the paddle shaft, placed immediately behind the lower end of the steam cylinder, which was horizontal. The wheels were fourteen feet diameter, projecting five feet, and were so constructed that the float boards could be raised to suit the draught of water of the ship; or they could be taken entirely away, if necessary, leaving the shafts projecting only eighteen inches beyond the sides. Under ordinary circumstances they were disconnected from the engine by a simple contrivance, consisting of a moveable head, attached to the crank on the paddle shaft, by turning which, one quarter of a circle, the crank pin was liberated, and the wheels turned freely round. The "Vernon," thus equipped, having on board nine hundred tons of cargo, and sixty tons of coal, drew seventeen feet of water. In the first trial the speed of the vessel, under steam alone, was five and three-quarters nautical miles per hour, demonstrating how small a power is necessary for a moderate speed. She then started for Calcutta, and though the piston rod broke three times during the voyage, owing to a defect in one of the paddle shaft bearings, the passage was satisfactory. The details are given minutely, as are also those of those homeward voyage, which was performed from Calcutta to London in eighty-eight days, to which must be added seven days for necessary delay at the Cape, making a total of ninety-five days, which is the shortest passage on record. Great credit is given to Captain Denny for the judgment with which he used the auxiliary steam power, and the course taken by him, by which he was enabled to overcome the difficulties incidental to a first trial of so important a system. The success of the "Vernon," induced the immediate application of engine power to the "Earl Hardwicke" Indiaman, and both these vessels are now on their voyage out to Calcutta.

This communication was accompanied by drawings of the "Vernon" and the "Earl Hardwicke," and by a chart, on which was laid down the proposed daily course of a steam ship, on a voyage to and from Calcutta, showing where sails only are necessary, then where steam alone, and also when the joint agency of steam and wind would be required. Also, the daily progress of the "Marquis of Huntly" Indiaman, of fourteen hundred tons burthen, on a voyage to India and China, and home, from the author's own observation, in the year 1816.

For the purpose of demonstrating the ratio of power to velocity, a Table was also given showing the velocities of ships of different tonnage, having steam power of various ratios, deduced from upwards of one hundred experiments on large steam vessels. The mode of disengaging the cranks was illustrated by models showing the gradation, from the complication of the first idea, to the beautiful simplicity of the present plan, which is now employed on board of the Government war steamers.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

April 19.

The Institute met for the first time after the Easter recess. Jos. Kay Esq., V. P., in the Chair.

Beriah Botfield, Esq., M. P., was unanimously elected an Honorary Fellow.

The Secretary announced the subjects for the prizes for the ensuing Session, viz. a restoration of Crosby Place, Bishopsgate Street, with the addition to the medal of ten guineas liberally offered by Miss Hacket, to whom the public are so greatly indebted for the preservation of what remains of that fine specimen of the Palatial architecture of the 15th century; an essay on the properties of light, shade and reflection in architecture, and another on the effects which may result to architectural design, from the general use of cast iron in construction.

A paper was read by Mr. Poynter, Fellow, on the state of Windsor Castle, previously to the erection of the existing *domus regis* by Edward III, in the 14th century. It is unnecessary to enter into any analysis of this paper, as the materials were drawn from a prefatory essay to Sir Jeffry Wyatville's illustrations of Windsor Castle, which will immediately be in the hands of the public: but that portion of it which was laid before the Institute, was made illustrative of a ground plan, in which the condition of the Castle, as it was left after the extensive alterations of Henry III. was laid down upon the authority of original documents, the greater part of which have now been brought to light for the first time.

A communication was read from John White, Esq., in pursuance of the subject brought before the Institute at a former meeting, the remains of ecclesiastical architecture in the pointed style, at Wisby, in Gothland. Mr. White's supplementary paper went to support, by the authority of Torfœus, and other historians, his theory on the date of those buildings, by adducing evidence on the advanced state of the arts in Scandinavia, as early as the tenth century.

The meeting adjourned to the refreshment of tea and coffee in the Library.

On Monday evening of the 26th ult., the President Earl de Grey, opened his house for the reception of the Members of the Society. The Council had the honour of dining with his Lordship, and the conversazione which followed was attended by a numerous party of noblemen and gentlemen eminent in art, science and literature. The Marquis of Lansdowne, Lord Prudhoe, Mr. Baron Parke, Mr. Rogers, Sir Edward Cust, Sir Henry Halford, Sir Henry Ellis, Sir Richard Westmacott, Sir Francis Chantrey, Sir Frederick Madden, Sir Gardner Wilkinson, Sir John Rennie, Sir Isambard Brunel, Professor Willis, the President of the Institute of Civil Engineers, Mr. Allan Cunningham, Mr. Copley Fielding, Mr. Ross, Mr. Harding, Mr. Haghe, and Mr. Joseph Nash were among the guests. A small party of ladies were also present, including the Duchess of Northumberland, the Marchioness of Lansdowne, &c. The tables were covered with works of art, among which Mr. Nash's splendid drawings of old English mansions were conspicuous.

RANDOM NOTES ON STEAM NAVIGATION.

"A very cursory survey of the various nations into which in the designs of Providence this earth of ours is portioned, cannot fail to excite our wonder and admiration of His master-workings for this our favoured habitation. While the British Isles appear a mere speck, as it were, upon the surface of the ocean, and are gifted with none of what are usually described as the more precious productions of nature, and while Golconda with her diamonds, and Peru with her gold, have scarce yet emerged from the obscurity of barbarism, we are naturally led to the enquiry as to *how* our little nation has surmounted the difficulties that might have daunted her energies and baffled her progress, and marched triumphantly forward until the clarion of her renown and the majesty of her sceptre have awed the very outskirts of the world. With a soil requiring laborious tillage for its culture, but with that abundantly productive of the necessaries and even the luxuries of life, with mines rich in the baser ores, yet prompting the researches of the chemist, the metallurgist, and the manufacturer, to administer to their profitable appropriation, and with such vast resources in her coal fields as have abundantly sufficed for the efficient development of her other subterraneous resources, her native energies have been kindled through difficulties. Scorning the limits of indigenous productions, the world has been ransacked for the gratification of her insatiable enterprizers. Nation after nation has bowed to her triumphant sway, while at home she has devoted herself to such subtle ingenuities as have, at length, evented in her careering through space with the velocity of the eagle, or trampling over the ocean as the mighty leviathan."*

A review of the progress and extension of the art of steam navigation would be the highest testimonial of its intrinsic and consummate importance Twenty years have scarce elapsed since, amid incredulity and ridicule, Fulton committed his little steam pinnace to the bosom of the Hudson; and long posterior to that event, the idea of traversing the ocean by the agency of steam was regarded as visionary and unattainable. Yet, within a few years, have we witnessed not merely the realization of this idea, but the extension of steam navigation to every part of the habitable globe. Every sea has become the scene of its triumphs—every land the recipient of its attendant beneficence. The frigid barriers of the pole have been constrained to attest its power—the dreary wastes of the Atlantic have been compelled to acknowledge its sovereignty. Art has usurped the dominion of Nature, and subjected even the elements to its sway. It would be difficult to form any adequate estimate of the effects on the moral and physical condition of mankind which may be expected to arise from the operation of this wonder-working agent. Every line of rapid and commodious communication between nation and nation is a channel through which knowledge, civilization and benignity will flow; and these main streams, by their subdivision into numerous minute ramifications, will transmit to the most obscure regions a portion of their invigorating influence, like the generous river of Egypt, which distributes its waters through innumerable channels to revive and fertilize the thirsty soil. Amid the general enlightenment resulting from these influences, national antipathies will be extinguished, and superstition and intolerance will cease to exist, and the irresistible progress of knowledge, the stately march of liberty, the happy approach of that period when the gorgeous East shall cease to shower on her kings *barbaric* pearls and gold, may be referrible to the achievements of modern ingenuity in the completion of this its most stupendous monument.

It would be irrelevant to our present purpose to pursue these considerations. We therefore proceed at once to announce our intention to embody, in a series of articles, the essential part of whatever information respecting steam navigation we ourselves possess, to explain those scientific principles which are essential to an intimate knowledge of the marine steam engine, and to communicate such practical details and precepts as extensive opportunity of investigation and considerable experience have enabled us to collect.

It is a circumstance which has frequently excited surprise and regret, that notwithstanding the important position which steam navigation has now universally assumed, there is yet no practically useful treatise devoted to its consideration. Dr. Lardner's elegant treatise on the steam engine is only adapted to the unprofessional reader, and the able treatise of Mr. Farey does not, in the only volume that has yet been published, embrace the subject of steam navigation. The recent edition of Tredgold contains much valuable information on the subject of steam navigation in the form of an appendix; but having been communicated by different individuals, it wants unity and sometimes consistency. Useful facts and valuable deductions are mixed up with inexact information and irrelevant narrative. To make a judicious selection from such a heterogeneous compilation to appropriate what is important and authentic, and reject what is valueless or inaccurate, pre-supposes the possession of that knowledge which it is the object of the student to obtain.

The production of a useful practical treatise upon the subject of steam machinery requires the agency of an able practical engineer, and there are few skilful engineers who cannot more beneficially occupy their time than in subjecting themselves to the unrequited labours of authorship. Among the makers of steam engines there are some who possess the requisite knowledge for the production of an able and valuable treatise upon the machinery of steam vessels, but independently of the importance of their time, there exists the strongest disinclination to reveal the mysteries of their profession, or to furnish any information relative to the qualities or nature of particular modes of construction. Each maker considers that he possesses some superior contrivance, arrangement or adjustment, the secret of which he desires to retain for his individual benefit, and the nature of which he endeavours to keep unknown even to his own workmen. Some regard the setting of the valves as their forte—others the proportion of their boilers, and others the peculiar mode of finishing or fastening certain parts of the machinery. The acquisition of a competent knowledge of the business of an engineer is in consequence an achievement of the utmost difficulty—information has often to be clandestinely obtained, and of the few who by dint of assiduity and good fortune, succeed in forcing their way into the sacred penetralia, appeared desirous to avenge himself for the labour, by excluding as many as possible of his neighbours.

We cannot but regard the secrecy which has been attempted to be preserved upon these subjects, as a reproach to the present liberal and enlightened age. It is a remnant of the ancient policy which nearly a century ago governed Boulton and Watt's establishment, and which, though at that time circumstances might perhaps have rendered it prudent and advisable, is at the present day inexcuseable and ridiculous. What secrets are they which the makers of steam engines have it in their power to conceal? Their works go abroad to the world, are cast in the course of events into the hands of other engineers, by whom they are dissected and criticised, when every peculiarity they possess is at once recognized and made public. Is it then expedient to reveal the existence of an illiberal spirit where it is impracticable to exercise an illiberal policy? Is it wise to proclaim to the world that we would desire to repress the interchanges of knowledge, and restore the ancient dominion of ignorance and empiricism? Have we the hardihood or the indiscretion to confess that with us impotency is the only limitation to restriction? "The whole tendency of empirical art is to bury itself in technicalities, and to place its pride in particular short cuts and mysteries known only to adepts; to surprise and astonish by results, but to conceal processes. The character of science is the direct contrary. It delights to lay itself open to inquiry, and is not satisfied with its conclusion till it can make the road to them broad and beaten: and in its applications it preserves the same character; its whole aim being to strip away all technical mystery, to illuminate every dark recess, and to gain free access to all processes, with a view to improve them upon rational principles.*" But it would be vain to expect that engineers will become converts to these enlightened views so long as their supposed interests lie in another direction—so long as they imagine the exercise of a craft to be more profitable than the practice of a profession, and that it is practicable to conceal, and yet employ the secrets of which they imagine themselves to be possessed. The constitution of human nature is opposed to such a consummation; and it would be too much to expect that our mechanical engineers should be an exception to the general disinclination to sacrifice accredited private interest to the cause of philanthrophy or of public duty.

The extinction of this spirit would be productive not merely of benefit to the community, but would enhance the reputation and promote the interests of our leading engineers themselves—we shall accomplish an object which we conceive ought to be generally acceptable, if we contribute to the obliteration of this, the only blot with which their fair fame is sullied.

It will be manifest from the title we have chosen, that in the observations we have to offer, we do not bind ourselves to an adherence to systematic arrangement—nevertheless we shall endeavour to thread all our memorandums upon the same string, and that too with some approximation to order. For the sake of continuity it will often be necessary to repeat what may have been said before: indeed we advance no pretensions to originality, although we are sensible it may be

* Thoughts on Steam Locomotion. Weale, 1840.

* Sir J. Herschell.

found that much of the information we may furnish is not to be found in any other publication.

The heads under which our observations will be given, are—

1st. Heat.
2nd. Steam.
3rd. Investigation of the reciprocal proportions of marine engines.
4th. Investigation of the requisite strength of the parts of ditto.
5th. Boilers.
6th. Practical details.

Critical and illustrative annotations by Mr. Farey, Dr. Lardner and others, will be appended, which, for the sake of distinction, will be marked with their respective initials.

Beth.

WESTMINSTER BRIDGE.

In the preceding volumes of our Journal we gave several notices of the repairs and improvements in progress at Westminster Bridge, and have now great pleasure in fulfilling our promise of continuing them.

The second coffer dam has been closed within the last five months, and a more successful result from work of this description we have never witnessed; indeed it appears to be one of the greatest triumphs of hydraulic engineering, to find a dam, (erected in a tidal river with a rise and fall of 18 feet of water, and exposed to every trial that one of the severest winters on record could subject it to,) so completely resist the efforts of its most insidious adversary, that after the wear and tear of five months, there is scarcely sufficient water from leakage to supply the ordinary demand of the works, and this too, on ground that was declared unsuited for the purpose, by the engineer who constructed the bridge, and by all who succeeded him up to the time when the present works were commenced, if we may judge from the way in which they carried on the repairs, and from the schemes for restoring it as exhibited in their reports.

The present dam encloses the 16 feet and 15 feet piers. Of the former we have only to observe, that the foundations were found similar to those in the first dam, the caisson resting on a bed of gravel, underneath which was the blue clay; they have since been secured in the manner already described in a former notice (vol. ii. p. 203), and the masons are proceeding with the new facing, of Bramley-fall stone, above the lowest low water mark, and also with the extension of the pier on the upper side, whereby the roadway may at any future time be widened 12 feet, without again having recourse to the expensive preparation of coffre dams.

The 15 feet pier is the one memorable in the history of the bridge, as having, by its sinking, delayed the opening to the public for three years, and given an apology to the party opposed to Labelye, (the engineer), to assail him with every slander that malice could invent, and by tampering with the commisioners, to nearly prevent the completion of the bridge according to his original design. How severely this treatment affected Labelye, we may see from a work published by him afterwards, in which he repels their attacks with great spirit, and with a bitterness that must have arisen from feeling himself deeply injured. We will here give a few extracts from this work, detailing the extent of damage done to the bridge by the accident, and the means he adopted to remedy it.

"On the 14th November 1746, the bridge and the roads and streets on both sides were completely finished, and the whole was performed in seven years nine months and sixteen days. The commissioners intended soon after to have opened the bridge for the service of the public, but were prevented by an accident entirely unforeseen, and not easily accounted for. In the months of May and June, 1747, the western fifteen foot pier was perceived to settle, very gently at first, but so much faster towards the end of July, that it was thought absolutely necessary to take off the balustrades, &c., by the continuation of the settling, the adjoining arches lost their semicircular figure, and considerable openings in the joints showed them in danger, some of their stones both in their fronts and soffits were split and broken, and one of them actually fell out of the least arch into the river."

The first steps taken were to carry up the two external piers of the two arches that were damaged quite solid, in rubble stone and mortar, to the level of the top of the arches, and to load them sufficiently, in order to preserve the other arches and piers of the bridge; centers were then put up to carry the two arches, and they commenced loading the damaged pier. The account of the last proceeding Labelye thus describes: "the whole weight of load placed on the said pier was so far magnified by writers of daily news and monthly magazines, as to be called 12,000 tons, while it never did exceed 700 tons, which was about a third of what I intended to load it with." What prevented this, was the influence of the party opposed to him, who persuaded the commissioners that further loading would be dangerous, and prevailed on them to give him orders to unload the pier, and take down the damaged arches." "This order," says he, "was the first and only one I ever received from the commissioners contrary to my judgment or opinion, and which I obeyed, *but I own not without some concern*."

We may here remark that the execution of this order, (as will be seen in the latter part of our notice,) has allowed the pier to remain in an unstable condition ever since, and had it not been for the successful repair lately effected, must finally have occasioned the destruction of a portion of the bridge.

His next proceeding was to inclose the foundation with 12 in. piles, and to rebuild the arches: "the dove-tailed piles were driven all round, close to the bed of timber on which the pier is built, and so deep as to reach about 15 feet under it all round, and afterwards were all sawn off low enough below low water mark, as never to be any obstruction to the navigation of any boat or vessel. Then the two damaged arches were rebuilt the very same in appearance, but with much less material in the inside."

After the preceding extracts, an account of the state in which the pier was found when the water was excluded from the dam, and of the works executed since then to secure its stability, cannot fail to be interesting to our readers.

On the removal of the ground about the pier, the joints of the dove-tailed piling, described above, were found any thing but close, and to make the matter worse, several of the piles had broken in the driving. As no dependence could be placed in this work, new sheet piling, of the same description as that used for the 16 feet pier, was driven all round, enclosing the foundation, thus at once preventing the escape of the finest particles of sand from under the pier. The old piles were afterwards sawn off at a low level, in preference to drawing them, as it was thought their removal might disturb the ground.

During the progress of driving the piles, considerable movement took place in the adjoining arches, showing evident symptoms of further sinking in the pier, and to prevent any injurious effect upon the masonry, strong shoring of whole timbers was fixed from the coffre dam to the soffit of the 64 feet arch, a precaution that has been attended with considerable advantage, as the arch stones have remained nearly uninjured, although several of the mortar joints were broken.

On the removal of the ground within the sheet piling, the projecting part of the timber bottom of the caisson was found to be broken and separated from that part underneath the pier, this had arisen from the space intended for the caisson not having been dredged sufficiently large to receive it, so that it was resting on the slope of the excavation, the centre part being hollow, until the weight of the masonry broke away the sides and allowed the pier to settle on the loose sand and gravel which had run in; the level of the blue clay being nearer the surface at this pier than the adjoining one, the excavation was principally in that material, and its intense stiffness will account for the dislocation that took place in the timber work.

The critical position of this part of the work required much caution, and in applying a remedy to so uncommon a case, we are glad to bear testimony to the most perfect success of the plan adopted; we have no doubt that this pier is *now* as trustworthy as any of the others that have been taken in hand.

The whole of the disturbed foundation timbers were removed, as also all the loose and muddy ground to the solid clay—the depth in some parts being as much as two feet,—under the foundations a body of concrete was filled in, level with the underside of the caisson, and to increase the bearing of the pier, timbers were laid parallel to the sides of the caisson, crossed by others placed 18 inches apart, and inserted to the length of 2 feet 6 inches under the masonry,—to insure their perfect bearing each timber was cut wedge form, and driven tight into the space it was intended to occupy. This operation was continued all round the pier, thus increasing its bearing surface about three feet on each side.

From that level a mass of brickwork was built, backed with concrete to receive the stone work of the pier, which in this case is to form a projecting footing of masonry, and the space within the sheet piling is to be finished with a capping similar to the other piers.

The masons are now employed upon this part of the work, and in extending the pier for widening the roadway, and if we may judge from the number of men employed, and vast store of materials provided, no very long time will elapse before the use of that magnificent temporary work, the dam, may be dispensed with.

We are happy in having had this opportunity of removing the uncertainty and error that has hitherto prevailed about the settling of this pier,—it has always been attributed to the ballast-men lifting gravel too near the foundations, and the late Mr. Telford and others in their plans for securing the piers, had only one object in view, that of preventing any further scour from the river—in the present instance we find that there was another and more serious danger to guard against, and that without the assistance of the coffre dam, the sunken pier could *never* have been made secure—on the contrary, that any attempt by driving piles or otherwise, if access could not have been had to the interior might have proved fatal to the adjoining arches.

We hope soon to have it in our power to announce, that the commissioners see that the time has arrived when they may confer a great and lasting benefit on the public, by widening the roadway of the bridge, "a consummation devoutly to be wished," by every one who has occasion to pass over it in its present narrow and crowded state.

ON THE POWER OF THE SCREW.

SIR—Permit me to offer you the following article which I hope you will deem worthy of publication in your Journal.

I am your most obedient servant,

J. R. CUSSEN.

Bruff,
March 30, 1840.

I have been often consulted as to the application of the screw as a mechanical power, and frequently found theory at variance with practice, this led me to an investigation of the rule generally used, for calculating its power, to practical trials of its power, and to an elucidation of a rule different from all those I know to be in use, which I trust will be found correct.

The Rev. Mr. Bridges in his work on Mechanics, p. 281, states, that P : W : : d : cirf. of cylinder, d being in his words the distance between two threads of the spiral, in p. 287, he says that p : W : : d : cirf. of cylinder, and P : p : : cirf. cylinder : cirf. of circle *ex æquo* P : W : : d : cirf. of circle ∴ $W = \frac{2\,p\,a\,P}{d}$, a = length of lever, but he makes $p = 3{\cdot}1415$, and also p = the power acting on the surface of the cylinder, thus making p in the same equation variable and invariable. In his application of the above formula he uses $p = 3{\cdot}1415$, but omits p = power acting on the surface of the cylinder, he adds in a note (*b*) that P : W : : d : cirf. of the circle. *Whatever be the thickness of the cylinder on which the screw is cut.* He then gives this rule. The power necessary to sustain the weight or produce the pressure will always bear to that weight or pressure, the ratio of the distance between any two spirals of the screw to the circumference of the circle which the power describes, that is $\left(W = \frac{2\,p\,a\,P}{d}\right)$ the weight to be raised or pressure produced is equal to twice the radius of the lever × 3·1415 × the power applied, and this product divided by the distance between the threads.

The first objection that struck me was why d should represent the distance between the spirals, and not the elevation of the inclined plane, or the elevation or depression obtained by each revolution of the cylinder, this is generally the distance between two threads + the thickness of the thread, or twice the distance between two threads; it is obvious that if the thread be ½ inch, and the distance between the threads ½ inch, that the elevation of the inclined plane, or the elevation or depression obtained at each revolution of the cylinder will be one inch.

The second objection was to the deduced conclusion that the diameter of the cylinder was of no importance, or that a screw of 2 inches diameter was as powerful as one of 12 inches or 100 inches. Suppose that no lever is used, and that the thread is the same in each, say ½ inch, and that the advantage obtained by the inclined plane be calculated we have for the 2 inch diameter screw 1 : 6·283 : : P : W, and for the 12 inch diameter 1 : 37·698 : : P : W, that is, the 12 inch diameter considering it merely as an inclined plane will sustain in equilibrio six times the weight with the same power that the 2 inch diameter screw will sustain.

That this power or advantage could be lost by the application of the same lever is absurd.

The third objection was to multiplying by the circumference of the circle formed by the extremity of the lever, instead of by the radius of the lever, as well may the circumference described by every lever be calculated, the error in calculating the power of the wheel and axle by the circumference would be apparent; in fact a screw is but a revolving inclined plane. Motion and power being communicated to it by a lever; moreover this inclined plane is properly speaking a fox-wedge, that is, two inclined planes of equal height acting on each other, for whatever space the threads of the screw pass over that of the nut, the threads of the nut pass over the same space on the threads of the screw, and both *i. e.* the threads of the nut and the threads of the screw sustain equal parts of the weight or pressure.

The power gained by the Rev. Mr. Bridge's formula by taking credit for the circumference of the lever, and dividing by but half the elevation of the inclined plane, is more than lost by omitting the advantage gained by the inclined plane in large screws, and the power of small diameter screws is overrated.

I am convinced that the true basis for calculating the power of the screw is P : W : : d : circumference of cylinder, d being the height of the inclined plane or the elevation or depression obtained by each revolution of the cylinder, then this advantage multiplied by the power applied, and the product divided by the height of the inclined plane, that is,

As the elevation obtained at each revolution, or as the height of the inclined plane,
: circumference of the cylinder,
: : the power applied
: the weight or pressure,

or $W = \frac{P \times \text{circumference of cylinder}}{d}$; the formula most generally wanting in use.

Suppose three screws, each of ½ inch thread, worked by a lever 90 inches long, the lever moved by a windlass of one ton power, the screws to be of 3, 6, and 9 inches diameter, we have the weight raised or pressure produced, by the

							tons.
3 inch diameter screw thus	1	:	9·4245	: :	90×1	:	848·205
by the 6 ditto	1	:	18·849	: :	90×1	:	1696·41
by the 9 ditto	1	:	28·2735	: :	90×1	:	2546·15

By the Rev. Mr. Bridge's formula we have for the three but one power, $W = \frac{2\,p\,a\,P}{d}$, *i. e.* $W = \frac{2 \times 3{\cdot}1415 \times 90 \times 1}{\frac{1}{2}} = 1130{\cdot}94$ tons.

It is to be remembered that one-third of the calculated power of the screw is lost by friction.

It is my opinion that the screw could be made to supersede the capstan in patent slips and dockyards, and that it could be used to the greatest advantage in submarine operations and excavations: its practical application to these objects will form the subject of another article.

COMPETITION.

SIR—A very suspicious looking advertisement having appeared in the Times of the 12th instant, offering a premium of 20*l.* for designs, estimates and specifications for a church to hold 800 or 1000 persons, to be built at Turnham Green, I applied according to the directions given in the advertisement, for information upon two or three points of some importance, viz. how much money it is proposed to expend—what means the advertisers would take to ascertain that the accepted design could be executed for the estimate which accompanied it—and whether the successful candidate would be employed in case he proved to be an architect of good reputation and experience. In answer to which queries I am informed,

"That the site is level and the soil gravel—
That the expenditure is not to exceed £3,500—
That one-third of the sittings are to be free—
That no vaults are required—
And that these are the only additional particulars the Secretary to the Committee can furnish."

Perhaps you can find room to publish this information for the benefit of the profession.

I am, Sir, your obedient servant,

B. T.

April 19, 1841.

Inclosed is my name and address.

Steam Navigation to the West Indies.—The first of the splendid line of steam packets intended to carry the mails betwixt this country and the West Indies, has been launched from the building-yard of Messrs. Duncan and Company, at Greenock. This vessel, which is 1600 tons burthen, has been named *The Clyde*, and is described as having a most perfect model. Her engines, made by Messrs. Caird and Co., are in readiness, and will be put in without delay. There are at present six of this line of packets, all of the same tonnage, building on the Clyde, four at Greenock, one at Port-Glasgow, and one at Dumbarton; and there is also one at Leith.—*Glasgow Argus.*

REVIEWS.

The Competition for the Nelson Monument critically examined. By John Goldicutt.

Thoughts on the Abuses of the Present System of Competition in Architecture, with an outline of a Plan for their Remedy: in a letter to Earl de Grey. By Harry Austin.

Perhaps no instance that has ever occurred, has shown the utter worthlessness of competition, under the present system, in so strong a light as that for the Nelson monument. The usual cases of fraud and imposition got up by parish officers and attorneys to extract designs from architects without undergoing the ceremony of paying for them, carry each its own stigma; but here is a competition established by a committee of men of unimpeachable integrity, with a sincere desire to elicit a design worthy of the nation, and what is the result? According to the opinion of an honourable and influential member of the committee, Lord Colborne, "there was not a single model or design that came up to what might have been reasonably anticipated, or which would justify the committee in selecting it as a fit and proper monument for so great a man as the hero whose achievements they were anxious to celebrate." Rotten must be the system which could produce such a result under such circumstances, if this judgment were true, or which could permit it, if untrue, to pass without general reprobation; and be it remembered, that the censure includes the design chosen, and now in progress of execution.

It is impossible to deny that the exhibition of the hundred designs and upwards submitted to the committee, was any thing but creditable to the state of British art, and such will be the character of all such exhibitions, as long as a system, or a want of system, is pursued which tends to keep every man who respects himself out of the field. It is certain that a very small proportion indeed of the artists who entered into the Nelson competition were of that class which the committee intended to encourage, and who might have been successfully encouraged with very little trouble; and of those few there is not perhaps one who has not sighed over the loss of his time and labour, which he might have assured himself before-hand would be thrown away. Here is Mr. Goldicutt, for example, who gives us a Jeremiad on the injustice of the Nelson competition. The question is obvious, why had he any thing to do with it, and what did he expect? Did he shut his eyes, his ears, and his understanding to all that was going forward long before the designs were received? Did nothing strike him as deficient or contradictory in the conditions and instructions put forth by the committee, which might have led him to suspect they did not quite understand their own meaning or know their own intentions: or to doubt their competency for what they had undertaken; or did it not occur to him that they had neglected the most ordinary precautions to assist their judgment and to secure fair play to the candidates? and did he make no inquiries to satisfy himself on these points? If he did not, others did, who found their remonstrances and suggestions rejected with the most self-sufficient obstinacy, tempered, it is but just to add, by the utmost courtesy to all applicants on the part of Mr. Scott. And then, why, in the name of common justice, were the competitors encouraged to exercise their invention through every conceivable modification of public memorial, from a simple statue to a full grown temple of Victory, when it was as notorious as the sun at noon day that nothing but a column had the remotest chance of acceptance. Enough had been said at public meetings by the most influential promoters of the scheme, to satisfy any one possessing an average share of observation, that the current set in that direction too strongly to be turned. Why, therefore, did Mr. Goldicutt take the trouble to deliver himself of what he might be very sure would be strangled for a monster in the Foundling Hospital to which it was to be consigned? Upon the taste or wisdom displayed by the committee in deciding upon a column in general, or on Mr. Railton's column in particular, or on any design at all if they were all so bad as Lord Colborne would persuade us, there is no occasion to give an opinion. Whether we consider a column the best of all possible monuments, and Mr. Railton's the best of all possible columns, or maintain the very reverse, in no way affects the conclusion—that gross mismanagement produced a result which seems to have astonished the committee, though it could produce no other, and that a great injustice was committed in not ascertaining beforehand, what was perfectly notorious, that the accepted design would be a column and nothing else, and issuing instructions accordingly. Those who play so recklessly with the labours of architects ought to consider that life is short and drawing paper dear.

For the mischiefs which arise to the profession and the public from the disgraceful state of competition, Mr. Austin steps forth with a string of remedies, every one more futile and inefficient than another, the grand nostrum being that the whole conduct of competitions should be placed under the management of the Institute of British Architects—a proposal very complimentary to the Institute, and one which they would only be doing their duty and carrying out their professions by taking into consideration. But setting aside several objections which occur, it is only necessary to mention one which Mr. Austin seems to have overlooked, viz. that the plenary authority of the Institute must be first recognized by all concerned, or likely to be concerned, and unluckily the parties most dipped in competition (may they speedily have it all to themselves,) are precisely those who are most interested in maintaining the *status in quo*. Besides, suppose the most satisfactory arrangements to be established, no one would be bound to abide by them, as Mr. Austin may see by reference to the Journal for October last, when he will find Mr. Serjeant Talfourd's opinion on the flagrant Bury St. Edmund's case. Nor is Mr. Austin more fortunate in his proposal that the author of a successful design shall, *in every case*, be intrusted with the superintendence of the building. What is to be done if a committee, acting *bonâ fide*, should pitch upon the design of an apprentice, an amateur, or a drawing clerk, or of one of that class of the profession (for, like the law, it is sorely infested with vermin,) who traffic in showy drawings and fraudulent estimates. And the fact is, that the designs of these classes of competitors (we beg to apologize to the three first for naming them with the last,) are precisely those best calculated to catch committees as they are for the most part constituted. Mr. Austin, indeed, goes in the very teeth of his own opinion in this proposal. "It is needless to say," he observes, in another place, "that those who send in designs honourably executed, alike fair to their brother competitors and to the committee, which they conscientiously believe can be built for the amount stated, are doomed to experience nothing but vexation and disappointment, and that if they could catch a glimpse of the committee in the very first hour of their sitting, they would most probably see them already sorting their modest designs from the showy and impossible draughts, and laying them aside with the flattering epithet of 'rubbish!'" This is perfectly true, and it is no less so that "the best chance of success under the present system rests with those who, knowing full well the utter ignorance of the men who are to decide on the real merits of the works laid before them, make this their stronghold and anchor of hope. They prepare designs on a scale of great magnificence, which, to carry out in their pristine grandeur, would cost twenty times the stipulated amount. They will be at considerable pains to render prominent the most striking portions of their designs, and to throw a veil over their various defects. They will employ skilful artists to prepare coloured showy elevations, and false perspective views of their principal features, to catch the Committee's unpractised eye; and knowing too well that these designs could not possibly be executed for any thing like the stated estimates, modestly assert, in their accompanying remarks, that much of what they show, (though all in all to their designs, such as they are,) might be omitted without the slightest injury to them. And the committee believe it, because they know no better."

"Is it not wonderful," we still use the words of Mr. Austin, "that so many should be found to engage in contests which experience teaches them are certain to be unsatisfactory and unjustly conducted." It is quite as wonderful that with so just an appreciation of the real state of competition, Mr. Austin should have gone so far wide of the mark in devising remedies.

Did the members of the profession never read the fable of Hercules and the carman? They are just now very much in the case of that same carman, shouting for help with all their might, but with less wit than the boor, for they do not know to whom they are shouting. We are nevertheless competent to give them the same advice that was delivered by the god—that each one should put his own shoulder to the wheel. Very deep they are in the slough, it is true, and a very filthy slough it is—so filthy that from mere communication the whole profession smells of it. Let every one who has not a taste for abiding in the dirt extricate his individual self, and keep cleaner ways for the future. To drop the metaphor, let every member of the profession who respects himself, resolve to enter into no more competitions, unless he is perfectly satisfied, after a strict examination, both with the conditions, and the integrity and competency of those who propose them, and let no one lose an opportunity of exposing in print every case of fraud and falsehood which may come to their knowledge. The example has been set in the pages of this Journal—let it be followed—and when the respectable classes of the profession are shamed out of promiscuous competition, and the public are awakened to the consequences, something may be effected to place the system, which nobody will deny to be thoroughly sound in its original principle, upon a satisfactory footing.—The following notice of a late trial will show how competition designs are often *got up*, but it is greatly to be lamented that committees are not often so competent and resolute in dealing with them:—

NORWICH ASSIZES.—*April* 7, 1841.

Brown v. *Langshaw*, Clerk.

Early in the year 1837, the parish church of St. Andrew the Great, Cambridge, was found to be in a ruinous condition, and a subscription was raised and a committee appointed for the purpose of rebuilding it. The committee applied to several architects for designs, and five were laid before them, among which that of Mr. Brown of Norwich, was conspicuous for its elegance and ornamental character—so much so, that the committee were not only greatly surprised at the high talent shown by Mr. Brown, in producing a design so superior to those of his rivals, and to any thing which had ever been imagined practicable for so small a sum as four thousand pounds, the limit set to the expenditure in the conditions accepted by the architects, but some of them also doubted the possibility of a *mistake* in Mr. Brown's estimate, an accident which does sometimes happen in affairs of this kind. As the architect professed himself to be perfectly clear on this point, his design was accepted and offered for contract. Several respectable builders of Cambridge having declined to compete, two tenders only were obtained, the lowest of which, instead of falling within four thousand pounds, amounted to something like six!—a dilemma which the architect was quite prepared to meet by altering his design so as to bring it within the prescribed limits. The majority of the committee (which was not composed exclusively of parish officers), being however troubled with a prejudice that such a course of proceeding might not be altogether just to the other parties who had expended their time and labour upon the faith of the conditions under which they were invited to compete, came to a resolution to dismiss Mr. Brown, who thereupon brought an action against the chairman, the Rev. Mr. Langshaw, to recover the sum of £300 and upwards, for preparing his designs. After keeping this action hanging over the heads of the committee for nearly four years, it has at length been tried as aforesaid, and upon the facts proved by the plaintiff's own evidence, the learned judge stopped the case, and a verdict was found for the defendant.

Observations on Railway Monopolies and Remedial Measures. By ALEXANDER GORDON, M. Inst. C.E. London: Weale, 1841.

Mr. Gordon is particularly known to the public for his great exertions for the introduction of the steam carriage on the common road, it is not perhaps so well known that he labours under a railway phobia, which is the cause of the production of the present pamphlet. This like all Mr. Gordon's works abounds with much that is valuable, but it is so tinctured with the expression of his prejudice against the railway system, that much of the weight of his remarks is counteracted. His zeal for the welfare of his profession is a prominent feature in his character.

Peckston on Gas-Lighting. Third Edition. London: Weale, 1841.

Mr. Peckston has been before the public for the last twenty years as a writer on this subject, so that we may fairly conclude that his merits must be pretty well known without any commentary of ours. We have now another edition of his work, embodying all the recent improvements, and abounding with all that extent of illustrations, which makes Mr. Weale's merits as a publisher of engineering works conspicuous. We do not recommend our readers to buy Mr. Peckston's book, because we know that if they want to acquire any information as to gas-lighting they must refer to him.

On Harbours. By W. A. BROOKS. London.

Mr. Brooks's work contains much that is new and valuable, it requires however more consideration on our part before we can adequately discuss the views put forward. In the meanwhile the engineering student may with advantage refer to this volume, which has evidently been written by a man of research and ability. It contains some good information as to the views entertained by French and Italian engineers.

A New Treatise on Mechanics. By the Author of a "New Introduction to the Mathematics." London: Whittaker & Co., 1841.

This is one of those laudable attempts to simplify a subject too often mystified, which is well deserving encouragement. The public are sure to gain by attempts of this nature, for though new errors may sometimes be introduced, more is gained by the removal of old ones.

Map and Section of the Brighton Railway. By J. R. JOBBINS. London: Grattan and Gilbert, 1841.

This map the scale of three miles to an inch, includes the whole of the Greenwich, Croydon, Brighton, Blackwall, West London and Thames Haven lines, the South Eastern to beyond Tunbridge, the Eastern Counties to Chelmsford, the Northern and Eastern to Broxbourne, the Birmingham to Tring, the Great Western to Maidenhead, and the South Western to Woking, with the country 25 miles north of London, 15 miles south, and 30 miles east and west, including the course of the Thames and the country between Windsor and Chatham. It seems to be executed with great accuracy, and for cheapness and extent of information is highly valuable, being equally useful either as a railway or general map. Appended to it are sections of the Croydon and Brighton lines, showing also by a novel plan the surrounding country.

Davies's Map of London and its Environs.

Mr. Davies's map includes all the recent improvements in the neighbourhood of London, giving the cemeteries, railway stations, and other matters. It includes the boundaries of the metropolitan borough, and much other useful information, so as to serve equally as a map of London and of the surrounding country.

MOTIVE POWER FOR IMPELLING MACHINERY.

Henry Pinkus, Esq., late of Panton-square, Coventry-street, but now of No. 36, Maddox-street, Regent-street, Middlesex, for improvements in the methods of applying motive power to impelling machinery, applicable, amongst other things, to impelling carriages and vessels, and in the methods of constructing the roads on which carriages may be impelled, enrolled March 24, 1841.

One of the improvements to which the patentee lays claim is what he terms the differential railway. It consists of a double line of railway, on which, at certain distances, is affixed a gas-explosive apparatus, described in the specification of a former patent obtained by him, provided with two large horizontal wheels, one above the other, round each of which an endless metal band passes; and between each apparatus thus described is an intermediate apparatus, provided also with a pair of wheels. The band proceeding from one of the horizontal wheels passes round one of the wheels of an intermediate apparatus placed in one direction, whilst the band from the other horizontal wheel passes round one of the wheels of an intermediate apparatus placed in the opposite direction.

The bands pass over wheels placed in the centre of each line of rails, and put those wheels in motion, which motion is communicated to the train of carriages by means of bars extending from the bottom of the same, and which are kept in contact with the wheels.

Another of the patentee's improvements is for a mode of propelling boats on canals by "gaso-pneumatic" power. Along the whole length of a canal, on one or both banks, a suspension rail is constructed, and along the canal, in a line with the rail, is laid down a gas main. On the rail is suspended an impelling machine, which consists of a frame running on wheels, and provided with two horizontal pulleys, round one of which an endless band passes from a pulley in the boat to be impelled, and in which is placed the gaso-pneumatic explosive engine. This engine actuates the pulley in the boat, which by means of the endless band communicates its motion to the horizontal pulleys, and they in turn communicate it to the running wheels, and cause the impelling machine to move onward and impel the vessel. Another mode of applying power on canals consists in using a steam engine in place of the gaso-pneumatic engine, to give motion to the impelling machine; and in order that boats may travel in opposite directions with only one line of rails, the impelling machines are made to move over one another when they meet, and so proceed on their respective courses.

The following is a mode of constructing roads or ways, also included in this specification:—In a given area of land a station is erected in a central situation, in which is placed an electric battery or batteries; or wells or tanks are constructed in any part of the said area. From the station, or from any of the tanks, a system of mains or pipes is laid down, and all along these, at intervals of from one to two hundred yards, are erected short vertical branches, terminating in a box with a moveable lid. In the mains are laid continuous metallic wires, and these wires are so arranged that when their ends at the station or tanks are brought into contact with the positive and negative poles of a battery, they constitute metallic circuits.

In order to put implements into action by means of this power, the patentee uses a locomotive engine similar to that described in the former specification, except that the cylinders, piston-rods, and their appurtenances are dispensed with, and the drum may be of smaller dimensions. Round this drum is coiled a pair of wires, and these are attached to a similar pair in one of the boxes before mentioned. To the locomotive engine an electro-magnetic engine is applied, and, in order to set the former in motion, chemical action is induced in the batteries at the station or tanks, and electrical influence is thus generated, the force of which, acting through the metallic circuit, will put the impelling engine in motion.

The patentee uses the electric power to prevent the collision of trains on railways, by causing it to put the breaks of carriages into action; he also attaches an electric battery to the locomotive engine, so that when trains are approaching each other, the battery being brought into action will, by means of connecting wires, apply the breaks, pull the lever of the whistle, and shut off the steam.

The patentee also shows a mode of constructing engines, and of actuating them by means of electric power.

The electric power is also used for lighting railways, tunnels, roads, &c.

An electric glow or "brush" is effected at the place required to be lighted, and being placed in the focus of reflectors, yields rays of light, which may be made revolving lights for night signals, &c.

In addition to the numerous improvements included in this specification, already noticed, there is one for a fire-engine to be worked by the "gaso-pneumatic power," to be drawn from the gas mains in the streets where the fire occurs, in the same manner as the water. [This specification occupies fifteen sheets of parchment, and there is also a corresponding number of drawings.] —*Inventor's Advocate.*

STEAM NAVIGATION.

THE NIGER EXPEDITION.

The expedition about to leave this country, to explore the River Niger, and which has excited such intense interest, consists of three iron steam vessels under the command of Captain Trotter, an intelligent and experienced officer of Her Majesty's navy. The two larger ones, the "Albert" and the "Wilberforce," are each of 410 tons burthen and 70 horses' power; and the smaller one, the "Soudan," (intended to act as a pilot vessel,) admeasures 250 tons, and has an engine of 35 horses' power. The two first are schooner rigged, and are remarkably fine-looking vessels, with lofty spars, and will display a large spread of canvass to the favouring breeze. They are fitted with Captain George Smith's method of stowing boats to form part of the paddle boxes, in addition to the usual complement of boats. They are heavily armed, and will each carry a number of Kroomen (a class of men accustomed to the climate, and found to be of eminent service), besides an efficient man-of-war's crew; and altogether, will prove formidable opponents should the natives venture to molest them, as they did the last expedition, under Messrs. Laird & Oldfield.

The interiors of the steamers are replete with every convenience, and even luxury, which can be desired. They are furnished with Dr. Reid's ingenious system of ventilating tubes (a kind of air filter) for the purpose of supplying fresh air in the 'tween decks; and which contrivance, it is confidently expected, will prove of great utility in protecting the crews from the debilitating effects of the noxious vapours which infest the vicinity of the River Niger, and which have hitherto rendered that climate so dreadfully fatal to Europeans. From their light draft of water they will be enabled to ascend a considerable way up the river, should they be so fortunate as to escape running hard aground, as from their great size it would be a difficult matter to get them off, especially should the crews suffer from the climate. The last expedition incurred great delays from the vessels continually getting aground; yet they were much easier got off than these would be from their being of smaller dimensions.

In conclusion we wish them every success, and must say that an expedition better calculated to fulfil its purpose never left the shores of this, or, indeed, any other country.

A comparison of the dimensions and draft of water of the steamers comprising the last and present expeditions, may afford an idea of the advanced state of steam naval architecture since the year 1832.

Last Expedition.			Present Expedition.	
	Quorra.	Alburkah.	Albert and Wilberforce.	Soudan.
Length	112 ft.	70 feet	130 feet	110 feet
Breadth	16	13	27	22
Depth	8	$6\frac{1}{4}$	10	$8\frac{1}{2}$
Horses power	40	16	70	35
Draft of water	6 ft	$4\frac{1}{3}$	$5\frac{3}{4}$	4
Built of	timber.	Iron.	Iron.	Iron.

The vessels of the present expedition were built by Mr. John Laird, of North Birkenhead, Liverpool, and the engines by George Forrester & Co., of Liverpool.

Auxiliary Steam Power.—We have to announce the departure for India, during the last month, of the "Isabella Blyth," a ship of 500 tons burden, fitted with a pair of small engines and paddle-wheels, to be used during calms and light winds, which, it has been ascertained on statistical data, prevail, on an average passage to or from India, during full one third of the time occupied by the whole voyage. To overcome this very serious difficulty, and ensure regular and rapid passages, the splendid class of vessels which now constitute our mercantile navy, appear to require nothing more than the successful application of steam power as an auxiliary. In order to prevent the great loss of power and increased liability to derangement resulting from one paddle wheel being immersed too deeply in the water when the ship is listed over, (while the other would consequently be entirely out of the water,) and also to elevate and depress the paddle wheels to suit the immersion of the vessel, which will, of course, vary not only with different descriptions of cargo, but also by the consumption of fuel, water, &c., during a voyage; the paddle wheels are fitted in such a manner that either wheel may, by the power of one man, be raised or lowered as occasion may require without stopping the engines. The greatest advantage will thus be taken of every breeze of wind, without any sacrifice of the auxiliary power. We feel assured that the ordinary paddle wheels which have, up to the present time, proved superior to every other propeller, only required this adaptation to render their application to sailing vessels perfect, and we therefore anticipate a very favourable result.

This vessel left the London Docks the latter part of last month, drawing 17ft. 6in. water, and after encountering more than the usual obstructions of the Pool, and proving in all her movements to be completely under the control of the steam power, the paddle wheels were adjusted to the proper depth of immersion, and the distance to Gravesend was performed in about four hours and a half. With the exception of a topsail being set during about twenty minutes, no advantage was taken of the sails.

Distinguishing Signal for Steam Boats.—We have been gratified, in common with a considerable number of steam-boat owners, captains, and others interested in steam navigation, by being shown a signal which will most admirably effect an object most desiderated, that of distinguishing steam vessels from sailing vessels at sea, and go far to prevent unhappy collisions and the destruction of human life. The inventor is Mr. Francis Melville, Buchanan Street, who, from a praiseworthy desire to promote the general safety, has devoted much of his time to the subject. Mr. Melville's plan is to place in front of the funnel of the steamer a lamp, with a clear light, and a strong reflector, having an external sliding cover attached to its face, so fitted as completely to obscure the light within, but to be made to move up and down the whole length of the lanthern, by means of a rod affixed to a small lever power connected with the engine, so that the motion or alternations of the slider would be at the rate of twenty in a minute. At the bottom is to be added a flat sole, made so as to carry the rays of light completely over the side of the vessel, in order that the reflection from any object on deck may not interfere with the pilot. By means of this simple apparatus, a signal will be produced perfectly distinct from any other known in navigation, and by means of it a steamer will, at the first sight, be known from any other vessel. Though the exhibition which we had the opportunity of observing was necessarily imperfect (being displayed from a window), enough was, nevertheless, witnessed to show at once the perfect practicalality and adaptation of the signal to the purpose intended.—*Glasgow Argus.*

Sixteen war-steamers are ordered to be built, six of the first class and ten of the second; all to be armed with guns of 10 inch calibre. Several of these will be laid down immediately, and the frames of the whole converted without delay, so as to be ready against the engines are prepared.—*Naval and Military Gazette.*

The Royal West India Steam Navigation Company have resolved to build six additional steamers. From the high recommendation given to the Clyde ship-builders by the Government inspectors, who have inspected the steamers now on the stocks, we understand that a few, if not the whole, of the additional steamers will be constructed on the banks of the Clyde. Three additional steamers are about to be contracted for by the Cunard Atlantic Steam Company.—*Glasgow Chronicle.*

The Mammoth, building by the Great Western Ship Company, at Bristol, will exceed 3,600 tons (about 600 more than any other ship in existence). The saving of room by her being built of iron will admit of her carrying coals for both the outward and home voyages, a matter of much importance from the inferior quality of American coal. Her engines are of 1,000 horse power. She will be enabled to carry an unusual quantity of canvass, and is expected to make the passage of the Atlantic in ten days.—*Liverpool Advertiser.*

MISCELLANEA.

The Duke of Wellington's Statue.—This colossal equestrian figure is rapidly progressing under the hands of Mr. Wyatt. When completed, it is expected to weigh about 50 tons, and to stand about 32 feet from the pedestal. If possible, it is to be formed entirely of the cannon taken by his Grace. The model of the horse, which is about half finished, is very fine. The gigantic animal, with eyes extended and nostrils inflated, is breathing with animation and vigour. The head and boots of the Duke are already cast. The face is an admirable likeness, as is well known to all who had an opportunity of seeing the model of it last year. These parts of the figure, which are all at present completed, have taken the metal of a single cannon. The lower extremities of the figure will be of solid bronze, the thickness grapually diminishing in the upper parts. It is said that the committee have appointed two years as the period in which the work should be completed, 11 months of which have already transpired, but it seems almost premature to fix a time for the finishing so elaborate and gigantic a work, especially when the process of casting is attended with so many risks that may cause a temporary impediment to its progress. During his labours Mr. Wyatt has acquired much valuable experience calculated to advance the art of casting in metal, among which are a method for testing the tubes which supply the metal to ascertain that they are perfectly clear, and a plan with the air tubes that causes them not only to expel the air, but also to operate as suction tubes to the metal, and promote its distribution. Another ingenious contrivance is a set of instruments, invented by Mr. Wyatt, for clearing off the metal with infinitely less labour than a common hand-instrument. This Wellington statue, when finished, will, it is supposed, be the largest hitherto known.

Primrose Hill, Regent's Park.—The Commissioners of Woods and Forests have, we understand, concluded an arrangement with Eton College, by which Primrose-hill will be preserved from being built upon. This place of healthful resort will therefore remain to the inhabitants of the metropolis, as one of the "lungs of London."

Artesian Well at Southampton.—The works on this important and spirited undertaking have been resumed; but after working one of the engines some ten hours, an accident occurred by the breaking of the fly-wheel shaft of the north engine—the cause of which it appears is not as yet accounted for. It seems that by the present arrangements immense quantities of water can be raised from the shaft to the surface, as, with only one engine and one pump at work, and those working only at one half the speed to which the engine is equal, the quantity of water delivered from the pump nozzle exceeded 12,000 gallons per hour; and this, too, when the water to be raised was upwards of 150 feet from the surface level. The present depth of the shaft is 300 feet, the excavation for a large portion of which is upwards of [illegible] feet diameter. We have reason to believe that for the purpose of obtaining a supply of water, there has been no other shaft constructed of so large a diameter, or with such durable material, or so great a depth. The difficulties encountered in sinking the shaft thus far have been of no ordinary kind, notwithstanding which, no one engaged in the undertaking appears to be discouraged. On the contrary, each misfortune appears to excite fresh exertions. The commissioners and contractors have decided to sink the shaft to a much greater depth, which, in our opinion, is far preferable to the plan of boring to so great a depth as was originally intended. We heartily wish the undertaking every success, but whatever the result may be, the inhabitants of Southampton will, by this work, solve the important problem, whether or not a copious supply of good water can be obtained by sinking a capacious shaft in a site so geologically situated as is their increasing town, and as is also similarly situated the great metropolis with its suburbs.—*Hampshire Independent.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 29TH MARCH, TO 27TH APRIL, 1841.

Six Months allowed for Enrolment.

JAMES TILDESLEY, of Willenhall, Stafford, Factor; and JOSEPH SANDERS of Wolverhampton, Lock Manufacturer, for "*improvements in locks.*"—March 29.

GEORGE EVANS, of Dorset Place, Marylebone, for "*an improvement or improvements upon trusses, for the relief of hernia.*—March 29.

ALEXANDER PARKES, of Birmingham, Artist, for "*certain improvements in the production of works of art in metals, by electric depositions.*"—March 29.

JOHN LINDSAY, of Lewisham, Esquire, for "*improvements in covers for water-closets, night-stools, and bed-pans.*"—March 29.

JAMES FURNIVAL, of Warrington, Carrier, for "*an expeditious mode of unhairing, mastering, and tanning various descriptions of hides and skins.*"—March 29. (Four months.)

THOMAS GORE, of Manchester, Machine Maker, for "*improvements in machinery or apparatus for roving, spinning, and doubling cotton, silk, wool, and other fibrous materials.*"—March 30.

JOHN ORAM, of Chard, Somerset, Machinist, for "*improved machinery or apparatus for making or manufacturing netted fabrics.*"—March 31.

WILLIAM JENKINSON, of Salford, Machine Maker, for "*improvements in machinery for preparing and spinning flax, silk, and other fibrous substances.*"—March 31.

JOSEPH GAURY, of Watling Street, Warehouseman, for "*a parachute to preserve all sorts of carriages using axletrees from falling or injury, upon the breaking of their axle-trees.*" A communication.—March 31.

JOHN GEORGE BODMER, of Manchester, Engineer, for "*improvements in the construction of screwing stocks, taps, and dies, and certain other tools or apparatus or machinery for cutting and working in metals.*"—April 3.

JAMES OGDEN, of Manchester, Cotton Spinner, and JOSEPH GRUNDY WOOLLAM, of Manchester, aforesaid, Commission Agent, for "*improvements in looms for weaving.*"—April 3.

WILLIAM EDWARD NEWTON, of Chancery Lane, Civil Engineer, for "*improvements in the process, mode, or method of making or manufacturing lime, cement, artificial stone, and such other compositions, more particularly applicable for working under water, and in constructing buildings and other works which are exposed to damp.*" (A communication.)—April 3.

ZACHARIA BRYANT, of the town of Nottingham, Machinist, for "*an improved method of manufacturing cloth and other fabrics from woollen, cotton, flax, silk, and other substances.*"—April 3.

JAMES ANDERSON, of Newcastle-upon-Tyne, Engineer, for "*improvements in windlasses.*"—April 5.

WILLIAM JAMES BARSHAM of Bow, Gentleman, for "*improvements in fastening buttons and other articles on to wearing apparel, and other descriptions of goods or manufactures.*"—April 5.

HENRY M'EVOY, of Graham Street, Birmingham, Hook and Eye Maker, for "*improvements in fastenings for bands, straps, and parts of wearing apparel.*"—April 5.

JONATHAN BILEY, of York, Brewer, for "*improvements in brewing.*"—April 5.

WILLIAM HUTCHINSON, of Sutton and Trent, Nottingham, Seed Crusher and Oil Cake Manufacturer, for "*improvements in the manufacture of oil-cake or seed-cake.*"—April 5.

WILLIAM LITTELL TIZARD, of Birmingham, Brewer, for "*improvements in apparatus for brewing.*"—April 5.

JOSEPH WILSON BUTFALL, of Belper, Draper, and HENRY HOLDER, of the same place, Tailor, for "*improved apparatus to be attached to trowsers, commonly called trowser-straps.*"—April 5.

JOSEPH APSEY, of Cornwall Road, Engineer, for "*improvements in the construction of flues for steam-boilers and other furnaces.*"—April 6.

CHRISTOPHER EDWARD DAMPIER, of Ware, Gentleman, for "*improvements in weighing-machines.*"—April 15.

FRANK HILLS and GEORGE HILLS, of Deptford, Manufacturing Chemists, for "*improvements in the manufacture of sulphuric acid and carbonate of soda.*"—April 15.

HENRY AUGUSTUS WELLS, of Saint John's Wood, Gentleman, for "*improvements in the manufacture of woollen cloths.*"—April 17.

PETER KENDALL, of Gifford's Hall, Suffolk, Esquire, for "*an improved method or methods of connecting and disconnecting locomotive engines and railway carriages.*"—April 17.

JOSEPH BARKER, of Regent Street, Lambeth, Artist, for "*improvements in measuring æriform or fluid substances.*"—April 20.

JOSEPH BENTHAM, of Bradford, Weaver, for "*improvements in weaving.*"—April 22.

HENRY BROWN, of Codnor Park Iron Works, Derby, Iron Manufacturer, for "*improvements in the manufacture of steel.*"—April 22.

THOMAS HARRIS, of Hales Owen, Birmingham, Horn Button Manufacturer, for "*improvements in the manufacture of what is called horn buttons, and in the dies to be used in the machinery of such descriptions of buttons.*" (Partly a communication.)—April 22.

HUMPHREY JEFFERIES, of Birmingham, Button Maker, for "*improvements in the manufacture of buttons.*"—April 22.

JOHN ROSTRON, of Edenfield, Lancaster, Manufacturer, and THOMAS WELCH, of Manchester, Manufacturer, for "*improvements in looms for weaving.*"—April 22.

FLORIDE HEINDRYCKX, of Fenchurch Street, Engineer, for "*improvements in the construction and arrangement of fire-places and furnaces, applicable to various useful purposes.*"—April 24.

LANCELOT POWELL, of Clydach Works, Brecon, Ironmaster, and ROBERT ELLIS, of Clydach, aforesaid, Agent, for "*improvements in the manufacture of iron.*"—April 24.

THOMAS ROBINSON, of Wilmington Square, Gentleman, for "*improvements in drying wool, cotton, and other fibrous materials in the manufactured and unmanufactured state.*"—April 27.

WILLIAM PETRIE, of Croydon, Gentleman, for "*a new mode of obtaining motive power by voltaic electricity, applicable to engines and other cases where a motive power is required.*"—April 27.

ALEXANDER SOUTHWOOD STOCKER and CLEMENT HEELEY, both of Birmingham, Manufacturers, for "*improvements in patten and clog ties, and other articles or fastenings of dress.*"—April 27.

BENJAMIN RANKIN, of College Street, Islington, Gentleman, for "*a new form and combination of, and mode of manufacturing blocks for pavement.*"—April 27.

OSBORNE REYNOLDS, of Belfast, Ireland, Clerk, for "*improvements in paving streets, roads, and ways.*"—April 27.

ANDRE DRONOT DE CHARLIEN, of Coleman Street Buildings, Gentleman, for "*improvements in preparing matters to be consumed in obtaining light, and in the construction of burners for burning the same.*" A communication.—April 27.

TO CORRESPONDENTS.

Maplin Lighthouse appeared in the last month's Journal.

Steam Engines in America will appear next month.

We are compelled to postpone several papers until next month; we must earnestly request of our numerous correspondents to favour us with their communications as early in the month as they possibly can, so as to ensure insertion.

Warming Buildings with Warm Water.—*We have received a communication from Mr. Richardson, and also an answer by Mr. Perkins to Messrs. Davies and Ryder's Report, given in last month's Journal, we very much regret that we are compelled to postpone both of them. We do not think it exactly correct to attack the report, until the experiments promised by Mr. Perkins are tried, we shall feel much pleasure in attending such experiments, and giving a faithful report of them, as we consider it a question of such great importance that it ought to be decided by facts and not by arguments.*

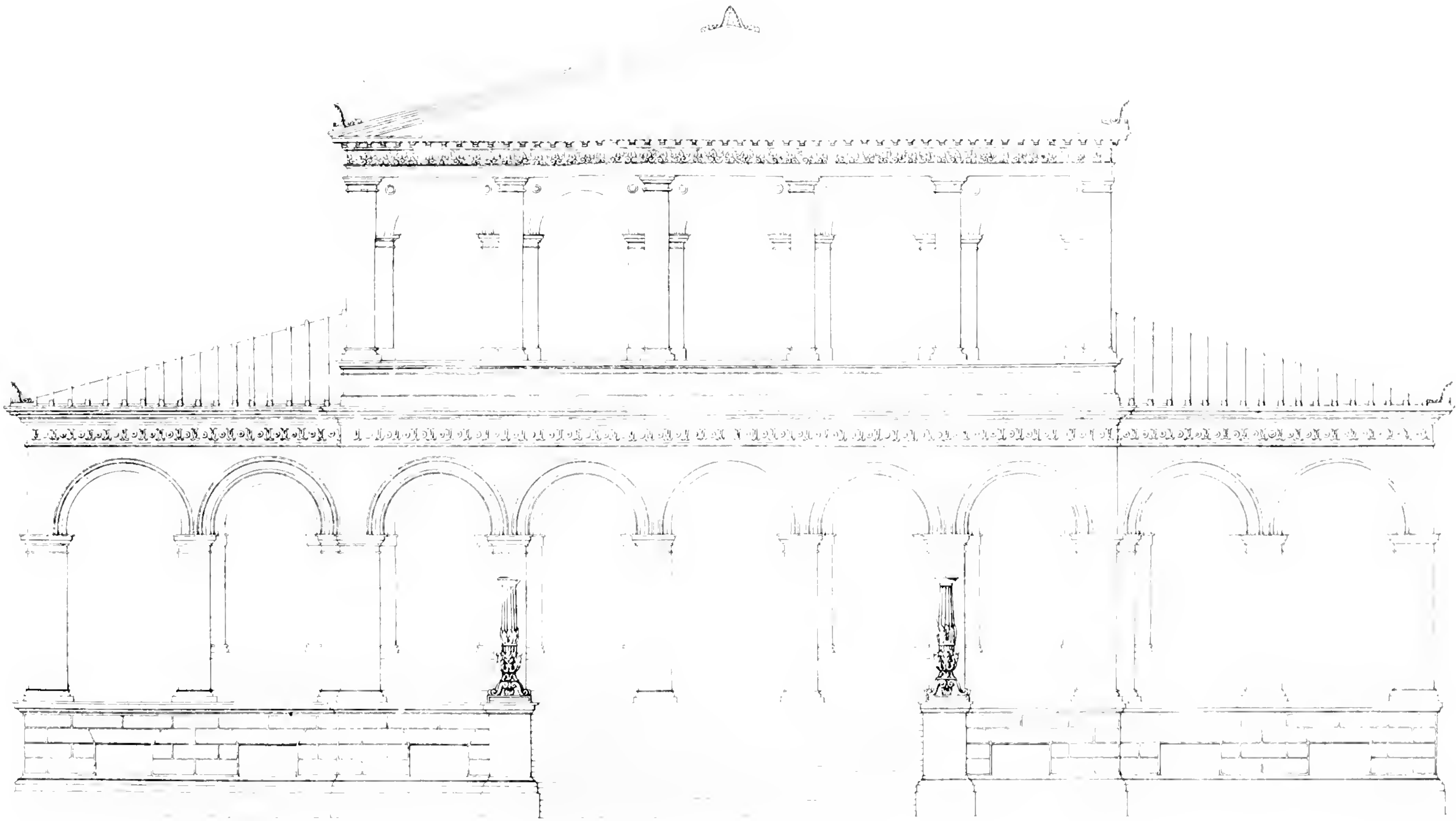
Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

The Kursaal Gebaude at Bruckenau

ELEVATION



J. R. Jobbins Lith. Warwick C.

Scale of Feet

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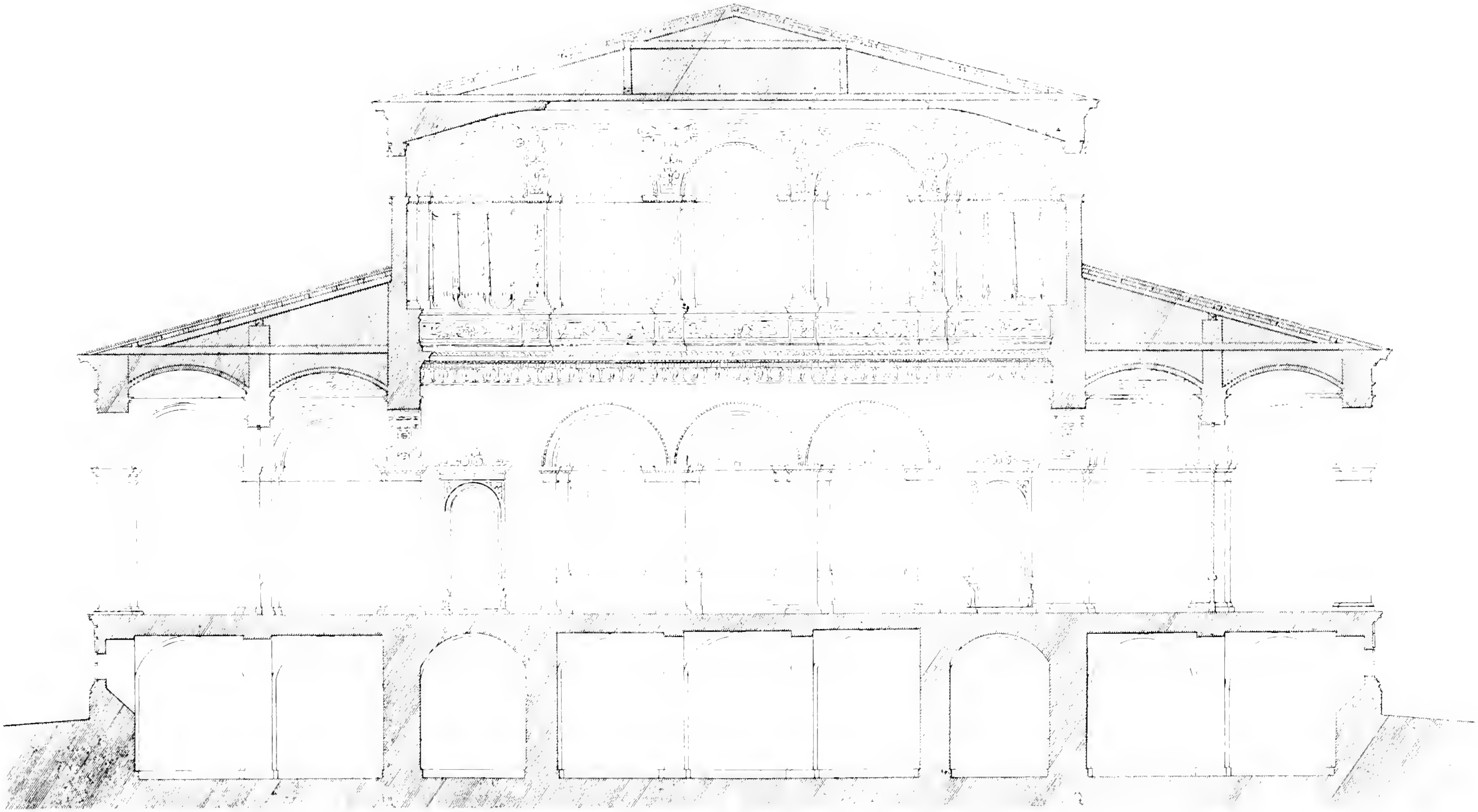
The Kursaal Gebäude at Brückenau

SECTION



Scale of Feet

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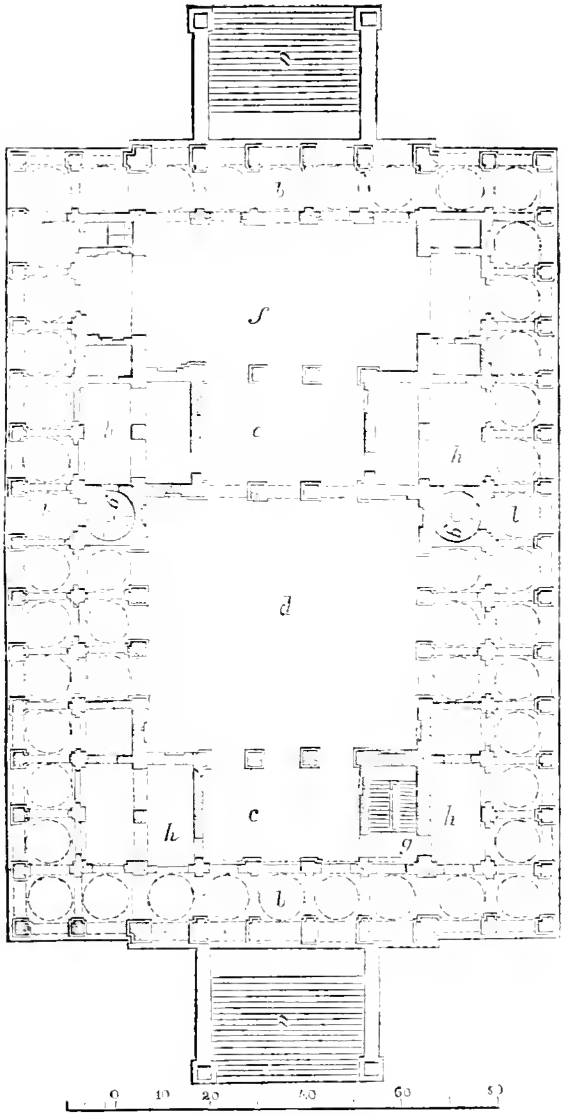
THE KURSAAL GEBAUDE AT BRÜCKENAU.

(With two Engravings, Plates V. and VI.)

Plan of Principal Floor.



Scale of feet.

a. steps; *b.* loggia; *c.* entrance hall; *d.* dining hall; *e.* intermediate hall; *f.* ball room; *g.* staircases; *h.* cloak and audience room.

It will not diminish the interest of the subject to our readers to know that, in his "Spas of Germany," Dr. Granville speaks of the *Kursaal* at Brückenau, in the following highly complimentary terms. "This is another of the great architectural works of which Bavaria may well be proud, and the idea and design of which were suggested by the King himself. It is the handsomest building of the kind I have seen in my general excursions in the Spas of Germany, and its various decorations are equal to any of the most exquisite productions of the Bavarian artists. On the right a grand flight of stairs leads to the king's gallery. The pavement is tessellated, and the *plafond* richly painted in stucco. From it depend five gigantic lustres which are said to give to the interior, on gala nights, the splendour of sunshine, lighting up every part of a building which for loftiness, daring proportions, and dimensions is such as an English people seldom witness in their public edifices. It is the production of Gutensohn,* a native of Lindenau in Switzerland, who having shown when very young, and at Munich, a considerable taste for architectural drawing, the King of Bavaria sent him at his own expense to Italy and Greece, to complete his studies. He is now residing at Wurzburg, and is employed in public works on account of the crown. I did not ascertain what such a public building might have cost in Bavaria, but it would be easy to calculate what sum would have come out of the Exchequer in this country, were such a one to be attempted."

So far the Doctor,—who at the time he wrote his description, had no idea that it would be tested by being confronted with any drawings of the edifice itself, or he would probably have expressed himself rather more cautiously, for as far as mere design is concerned, there certainly is nothing remarkably striking in the exterior of the building: it is in a good though simple style, and possesses a certain propriety of character; besides which it has the advantage of being insulated, and of strict consistency being kept up in every one of its elevations. It should also be borne in mind that much of the effect attending the building itself—of the play of perspective and of light and shade produced by the open arcades enclosing the whole of the lower part above the basement,—is necessarily lost when the design is exhibited only in separate geometrical drawings. On the other hand, we are of opinion that consistency and uniformity have been pushed somewhat farther towards monotony, than there was any occasion for; and that the design would have been improved by having a little more variety thrown into it. Neither is the building at all remarkable for its size, the extreme dimensions being only 112 by 165 feet English.

In fact we must presume that Dr. Granville's admiration was excited chiefly by the interior and the style of its decoration, but we think that he has there also a little magnified some circumstances,—for instance when he tells us of a grand flight of stairs leading to the king's gallery; because the plan shows that staircase (*g*) to be a very confined space. Still there is undoubtedly much architectural grandeur and considerable scenic effect in the *Saal* or saloon itself, which rises the entire height of the building, and which may be said to occupy nearly the whole of the ground floor, the *Tanzsaal* or ball-room being in continuation of the other, though less lofty, and divided from it only by an intermediate compartment (*e*) having three open arches towards either of the other rooms. The decorations of the larger saloon, which is used as a dining or banqueting room, and of which a large perspective view is now lying before us, exhibits a tasteful application of the Renaissance style, or rather that of the Loggie of the Vatican. The deep and spacious royal tribune or loggia which is seen through three open arches in the upper part of the saloon, must have a strikingly splendid and scenic effect. As regards this portion of the interior, generally, we are of opinion that it contains much which would be exceedingly appropriate and applicable for the interior of an Exchange, with a covered area, lighted from above through a series of lunettes or semicircular windows (which might be left unglazed) just below the ceiling.

To quit these remarks of our own—which ought perhaps rather to have followed than preceded explanatory description, we return now to the latter. The building, begun in 1827, and completed within four years, stands upon a gentle declivity, in a beautiful valley, at no very great distance from the mineral spring, and from the baths and lodgings for visitors at the Spa. The edifice is raised upon a stylobate or low rusticated basement, containing the kitchens, cellars, and other offices, with the requisite accommodation for the domestic part of the establishment; which rooms are about 12 feet high, the floor being about four or five feet lower than the ground level. A flight of steps (*a*) at each end or front of the building leads up to the open loggia which forms a covered terrace quite around it, where the visitors can promenade, and enjoy the surrounding scenery. This loggia (*b b*) consists externally of 46 arches—viz. 14 on each of the longer, and 9 on each of the shorter sides or fronts,—and internally of 42 square compartments covered by as many small segmental domes. The larger Saloon or Dining Hall (*d*) is 54 feet (English) square, and 44 high: and its ceiling which is flat, has a cove intersected or divided into spandrils by the lunettes or arched spaces over the upper windows groining into it. Both the ceiling itself and those spandrils are richly decorated, as are likewise the panelled pilasters between the windows and upper arches, and also the podium upon which they rest. In its lower part or floor-plan, this Hall is greatly extended by the recesses or additional compartments, with which it is connected by three open arches on each side, and including which the dimensions become 88 feet English in the longitudinal, and 82 in the transverse direction of the plan. The *Tanzsaal* or Ball-room (*f*) measures 56½ by 30 feet, or including the recesses at its ends, the total length is 80½ feet. This room is very differently proportioned from, and by no means so lofty as the other (which approaches to a cube), the height here being 26 feet, or 18 less than that of the other.

* Johann Gottfried Gutensohn was born at Lindenau, on the Lake of Constance, in 1792. In conjunction with Knapp, he published a work on "Basilicas," 1822-6; and afterwards with Thurmer, another on the Italian architectural decoration of the 15th century. In 1832 he proceeded to Greece, as architect to King Otho.

The exterior of the building is entirely of wrought stone, of a quartz-like species, and of an exceedingly hard kind. Taken therefore altogether,—considering the solidity of its construction, the regularity of its design, and the richness of its internal decorations, this edifice is a very superior one of its class, and although of no very great extent, fairly deserves to be considered as a "monumental" production of the art.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXVII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Seeing what Mr. Barry has done in the two Clubhouses designed by him in Pall Mall, methinks people might by this time perceive how much more might be accomplished by carrying on to a greater extent the same mode of treatment, and making the dressings to the windows not only finishings to those apertures, and proportioned to them, but so to be in a manner proportioned to the whole design, and to become important decorations of it. At present, though their mouldings may occasionally be richer than usual, there is little variety in the design of windows—little at least, in comparison with what there might be,—as regards composition and general character, such dressings consisting of no more than an architrave around the aperture, surmounted by frieze and cornice—either with or without the addition of pediment; or if something more than this be required, it is obtained by either small columns and pilasters. Yet wherefore should we confine ourselves to that as the very *maximum* of decoration allowable for such features, when window-dressings may be treated arbitrarily, that is, with artistical freedom instead of being invariably only the *echoes* of the parts belonging to a large order? Of course, one objection will be that they cannot be at all exaggerated without producing heaviness; another that the doctrine of arbitrary treatment, is nothing more than that of universal license—which would soon be universal architectural licentiousness. But according to the first objection, the cornicione of the Reform Clubhouse, ought to be offensively heavy, for it certainly may be characterized as being exaggerated. And with regard to the second, it would be better to run the risk of being scandalized by a little licentiousness in design now and then, out of fear of it—than to doom ourselves to what, if not exactly monotonous insipidity, excludes a great deal that would be good though of a different kind of merit. Most assuredly there is no danger whatever of our Anglo-Athenian school falling into any excesses as regard the decoration of windows or any thing else. No need to caution them against giving the reins to their imagination, and indulging in architectural frenzies. Their buildings may be chaste—for as the man said of his Aunt Deborah, they are so confoundedly prim and ugly that their chastity is proof against all suspicion.

II. Theodore Hook seems to entertain about the same kind and degree of affection and admiration for Railways, as I myself do for Palladio, or *caro mio* Bartholomew does for architectural competition. Whenever he can, Hook is sure to have a slap at the unfortunate Railways: witness among other instances the following comparison:—"it must as inevitably annihilate their hopes as the *incidental* tumble of a train off the railway settles the fate of the infatuated passengers of the iron hearses invented for the purpose of cheatery and monopoly, to supersede good old English horses and carriages, and the best roads for travelling in the world"! Most undoubtedly travelling by those 'iron-hearses' is not quite so aristocratic, dignified and luxurious as posting a journey in a chaise and four, preceded by a courier; still for the million the newer system has doubtless its advantages—vulgar ones though they be—or it would never have been encouraged to the extent it now is. When people can afford it, it is all very well for them to give themselves as many consequential and impertinent would-be-fine airs as they please; but is not Hook himself the driver or *conducteur* of a literary omnibus, started professedly *pro bono publico*, and always ready to *take in* and to be taken in by as many readers as it can obtain—the more the merrier?

III. S. L. has my hearty leave to inveigh against the application of Gothic to modern domestic buildings, if by Gothic he understands such frightful absurdities as was the so-called Gothic Dining-room at Carlton House, which had a flat ceiling—painted to imitate sky and clouds—just over one's head, and ugly brackets for lamps attached to it! It is said that that more astonishing than admirable specimen of taste was concocted by the united genius of George IV. and Messrs. Nash and Soane. What a triumvirate of talent!—worthy of Bartlemy Fair. Never was man more innocent of any feeling for grandeur in architecture than was that his 'Most Gracious Majesty.' There certainly is no royal road to taste; but then if he happens to have none himself, a prince should know where it is to be purchased ready-made, and take care that he be not imposed upon by Brummagem counterfeits,—and poor John Nash's taste was Brummagem to a degree it is now most mortifying to reflect upon. The time—so we are assured—will come when Brummagem alias Buckingham Palace, will have justice done to its merits; which time will arrive when it is pulled down, and not a day before. There is indeed one purpose to which it might properly enough be converted, viz. to that of a Royal Nursery, because in such a case the babyishness of its architecture would be in character.

IV. By no means is it uncommon to hear sneering remarks on the folly of those who build beyond their means, yet for one man of fortune who so dips his property, there are fifty who impoverish or embarrass themselves by other extravagances of various kinds, which escape censure either because they are more like the follies of other people, or because instead of showing themselves to the world as a single *corpus delicti*, they are a legion—inconsiderable when taken separately, although collectively most formidable. After all there may be a great deal of what the world calls extravagance, combined with true economy, and *vice versâ*. Our own times afford a splendid instance of what may be accomplished by magnificent economy. See what Louis of Bavaria has done for Munich, and for every branch of the fine arts in that petty capital! In this country had it been proposed to do but half as much, people would have cried out, Impossible! Had John Bull been asked to furnish two millions for a royal palace that would have been an honour to the nation, John would have turned confoundedly sulky, and buttoned up his breeches pocket in a huff. However John is liberal in his way, and also likes a bargain, therefore does not grudge half that sum to erect what is a disgrace to the country; flattering himself all the while, poor dupe!—that whatever be said of his taste, he is most certainly a pattern of economy. 'Two millions,' it must be confessed, has a most awful and startling sound upon such an occasion, but of the plurality of millions which leak out by perpetual droppings and drippings no account is taken. Could we but see the sum total of what has been squandered away at different times on paltry knick-nacks and ephemeral gewgaws,—on Kew Palaces and Carlton Houses,—on fetes, fireworks and other solemn tomfooleries, we should stand both aghast and abashed. But even were it doubled, that tremendous sum would not have been expended in vain, if it had purchased us a knowledge of true economy and wisdom for the future. Unfortunately, we seem to have very wrong-headed notions of economy, generally contriving to be at once shabbily penurious and recklessly extravagant in our public undertakings. As regards private economy we are not always very much wiser. However I will not go into that subject, further than to illustrate my text by the following short dialogue between two young men whose allowances were nearly the same. 'I cannot for the life of me, understand,' said one, 'how you possibly contrive to buy so many splendid publications, prints and pictures, I'm sure I can find money for nothing of the kind.'—'So I suppose,' replied the other, 'but then, my dear fellow, you have the satisfaction of knowing that you spend quite as much or more, on cambric handkerchiefs and kid gloves.'—Ah Johnny Bull, Johnny Bull, it is the cambric handkerchiefs and kid gloves,—the expensive fripperies of the day and the hour, that run away with your cash, and leave you none to patronize and advance art. Wastefully profuse in trifles, you generally show yourself exceedingly stingy where extravagance would be rather a virtue than a fault; or else you suffer yourself to be egregiously taken in under the idea of getting 'a capital bargain!' And it is fortunate if your bargains do not make you the laughing-stock of all Europe.—I declare I am growing quite patriotic!

V. Continuing the subject, it may be observed that our merchants do not emulate those of Florence and other Italian cities during their palmy state, in the encouragement of architecture and its sister arts. Is it because they cannot afford to erect noble palazzi and stately mansions?—And yet there are many among them to whom the price of such an edifice as the Reform Clubhouse would be a mere bagatelle. Some of them may be extravagant enough, but there is nothing magnificent in their extravagance. The money goes, perhaps, fast enough, but it goes vulgarly,—in eating and drinking,—in giving expensive entertainments to people who will *condescend* to be seen at them, pinching their pride for the sake of filling their bellies with the luxuries of a citizen's table. Or else the money does not go at all, except that it is let to go on accumulating until some '*beau matin*,' as the French say, the newspapers inform us that Mr. Snobbs or some other indefatigable money-grubber, like the Shoemaker of Bishopsgate

Street, is just dead, and has left property to the value of nearly one million sterling: *sic transit gloria mundi*.—I declare that I am getting quite edifying.

THE PALLADIAN SCHOOL OF ARCHITECTS.

Associated with the Palladian architects, is a name deservingly worthy of mention, for it is that of Kent. The taste of this ingenious artist, found, as it is, in the English mansion and in the palaces of the great, charms us at first by its luxuriance, and then leads us to closer inspection, from a certain correctness of feeling aptly displayed. His claim to this fellowship with the Palladian school rests upon the felicitous manner in which he caught its sentiment, and the rich and varied assistance he threw into the Palladian structure. Confining his efforts more to fancy than to skill, subduing his proportions more for the eye than for utility, he comes before us as the artist rather than as the architect, lavishing his exuberant ideas upon an interior, and unfettered by the many annoyances to taste which the calculating architect feels. There is an air of poetry in his conceptions admirably adapted to soften and to please; forms of carelessness and ease crowd around to soothe the wealthy inmate: there are the gleanings from nature appreciated by all, and there classic forms and allusions appear to enchant the refined.

Kent was one of a class who are lovers of antiquity, and over whose minds its wonderful creations act like a charm, and in whose hearts its beauties feed a passion. We find such painting the sky and peopling it with angels; throwing upon the walls figures of elegance, quaintness or dignity; carrying the whole harmony of a design into the saloon or gallery, and scattering it amidst an assemblage of forms without perplexing any: making the design to appear conspicuous and happy, even when associated with the noble, free, and graceful outlines of the sculpture.

I have placed Kent thus soon in the list of the artists of his school, from the necessity there appears to be to introduce to the notice of the influential, men of his particular stamp of genius. Not so much to criticise the excellencies of design, as to hint at the talents of many, gifted as he was, who are forgotten or despised, in the rush after foreigners. It would be well for the sapient, spectacled virtuosi (who sniff talent from the south long before the genius of their choice is born), if they would take their cold, starch, accommodating fancy into some of the mansions graced by his free yet careful hand. Why do the fraternity hesitate to patronize native genius? Why do these gentlemen, whose very fancy comes, like mushrooms, out of impurity, turn their squeamish patronage elsewhere? There must be some miserable prejudice afloat in the world of art, arising out of pedantry, and inflated efforts after imitation, to account for this. It must be that certain cold natures turn southward, or abroad, conscious of their own frigidity and death-like fancy; but it is not that there is no genius, native to all that is beautiful and fair, that these ghost-like Mecænases hurry about, like unquiet spirits, for their favourite.

Oh, when shall this age of precedent form a school of its own? when shall architecture and her sister arts be found linked in the embrace of nature, when shall Englishmen incite their countrymen to zeal, and art glow with the colouring of health and truth? It is no mean and trivial thing to design an interior. The very consciousness of entire freedom, leads a poor artist into profuseness, and if he seeks a relief by subduing a part, the meagre and shallow forms that appear attest his poverty of mind. The aim in the interior is opposed in every sense to the exterior, at which the passer by is to be arrested, and from which he is to judge of the pomp or dignity of the inmate. In the interior, the *pleasure* of the inmate has to be sought, and the artist has to borrow from the treasury of his fancy, every device which can divert and tranquilize. Through the contemplation of these the mind must unbend and relax into tranquil pleasure. How rich, then, and varied in its conceits, how sensitive in its structure, how refined and delicate, how acute in its parts, must be that mind which can conceive and execute a design so potent in its effects. It is not mere imagination, it is more; it is the imagination cooled and schooled, training its active and perpetual creations according to principle and rule, until it form a picture faithful and real, the original materials of which are in nature. It is not mere fancy either which admires the production, it is rather the fancy compelled by a skilful adaptation from nature of proportion, harmony, and grace, and which is, in truth, the mind affected under a *familiar* not an *artificial* influence.

Hence those artists who sport with flowers, and who fling, with a seemingly careless hand, into design the lighter beauties of their art, deserve attention, and deserve too, the same protection, assistance, and name, as Kent received; but whose talents must droop and wither so long as art holds in her body those worms that gnaw away her sickly vitals.

May 10. FREDERICK EAST.

ARCHITECTURAL ROOM, ROYAL ACADEMY.

We will dispense with further animadversions on the accommodation afforded to, or rather, withheld from, this department of the Academy's annual exhibitions; not because the slightest improvement in that respect has taken place—not because there is no longer any occasion for the observations we have already made at different times, but because they may be repeated 'till farther notice,' as the playbills say,—that is, to the end of the chapter, and until the Royal Academy, painters, architects, and all shall have become *Faimus Tro*—.—And truly, if architects themselves generally, and the Professor of Architecture in particular, can patiently tolerate a system which produces to them an annual insult, we do not see why we should allow ourselves to be at all ruffled and put out of temper by it. Patience and long suffering are no doubt virtues, and accordingly, as far as the Academy is concerned, architects show themselves the most virtuous of the human race;—not but that there are bounds even to patience, and if pushed beyond them, the illnatured world are apt to call it sheer dullness and stupidity.

In regard to the actual contents of the Architectural Room this season, we regret to find so very few designs for buildings of any promise or importance, among those either in actual progress, or definitively determined upon. We see many competition drawings, but then they are for the most part only rejected ones, while those which are adopted are kept back. For the Assize Courts at Liverpool, there are no fewer than ten different designs—some of them rather indifferent ones—including the successful one by Mr. Elmes, jun. But all of them are now, it seems, set aside, it being now intended to comprise the Courts and the St. George's Hall in one building. We will, however, first pay our respects to the Professor of Architecture, who modestly contents himself with exhibiting a single drawing, and that of a rejected design,—viz. No. 993, described in the catalogue as "A Study for a Front of a Public Building," which turns out to be neither more nor less than his design for the West Front of the Royal Exchange, engravings of which were published some few months ago in the Westminster Review. It certainly is not deficient in richness, and has the merit of avoiding that now common-place feature, a portico treated without any kind of originality, and brought in for the nonce, whether there be any thing else to agree with it or not. Still, it appears to us, keeping has not been sufficiently attended to, there being a disproportion between the large parasite columns and the rest, for not only do they overpower some of the other parts, but actually squeeze them up and encumber the façade unnecessarily and unmeaningly. It further strikes us as singular that Mr. Cockerell should not have exhibited his model for the same building also, as, besides that it would have been a striking object in the room, and would have explained the whole design, we have heard it spoken of as abounding with many effective parts. Still even if he chose to withhold that, we think he might very well have permitted us to see the designs of some other buildings either in progress or about to be begun by him, for instance the New Libraries at Cambridge, the Sun Fire Office at the corner of Bartholomew Lane, and the Taylor and Randolph Institute, at Oxford. Not having chosen to do so, he has no right to be very much astonished should some persons draw unfavourable inferences from it, and impute it to something like a consciousness on his part that none of those designs are calculated to raise his professional reputation.

Like Cockerell, Mr. Barry exhibits only one design, yet that one is altogether new as to subject, and of considerable importance. We were aware that Mr. B. had been commissioned by Lord Francis Egerton to prepare a design for Bridgewater House, but hardly expected to be gratified with sight of it so early. With regard to the subject itself, it will not detract from his high reputation; at the same time we question whether it will add to, or we should say, will raise it very much, since an edifice of such a character and upon such a scale must of course extend its author's celebrity. Grandeur and stateliness it certainly possesses;—and that is something, or rather a very great deal, considering how very rarely we obtain those qualities or any thing like them in structures where we might reasonably expect to find them, and from which they certainly have not been excluded by severe economy,—for instance, the unfortunate and deplorable *à la* Regent Street Buckingham Palace. Bridgewater House is noble and princely in aspect, which is what cannot possibly be affirmed of those two ducal mansions, Stafford House, and Wellington or Apsley

House, which last is so remarkable for nothing as for its smugness and spruceness, for its utter want of dignity, and downright insignificance of manner. Still though there is a fine architectural feeling pervading the whole of Mr. Barry's design, we cannot say that it is marked by originality, notwithstanding that a mansion of such a character will in itself be quite a novelty in the metropolis. It will be a large, oblong and insulated pile of building, two sides of which are shown in the drawing (No. 981), viz., the South and West, the latter facing the Green Park. Judging from what we see, we presume that the same architectural character will be kept up throughout the whole of the exterior, and that the North side will be the principal entrance front, there being there a square tower carried up a story higher than the rest of the edifice, from which we conjecture that the lower part of it will form a carriage porch. The summit of this tower shows itself picturesquely in the view above the general mass of the mansion, and is, no doubt, intended to serve as a sort of belvedere,—an appendage certainly uncommon, but in this instance justified by the locality, in the immediate vicinity of the Parks. We may describe the design generally—at least what is here shown of it, by saying that it consists of a rusticated basement or ground floor, with a continuous Corinthian order, comprising a principal floor and mezzanine; the whole surmounted by a balustrade and vases of globular form. Both the elevations which are shown are perfectly similar in design, except that the South front, which has fifteen intercolumns, consequently so many windows on each floor, has pilasters, while the West front or end towards the park, has three-quarter columns, and six intercolumns less, or only nine windows on a floor. In both elevations, all the windows of the principal floor have triangular pediments, and the mezzanine ones keystones to their architraves. The angles of the building are strengthened by coupled pilasters, so that two adjoining ones exhibit a group of three of them. It should further be remarked that the superstructure is in some degree rusticated as well as the basement, the jointings of the stone being shown on the surface of the walls between the columns, &c. This must suffice in the way of description,—which however exact, can merely enumerate the several items of a design, without exhibiting their aggregate effect; and the particulars we have noticed will serve as an outline of this composition of Mr. Barry's. The size of the building may be tolerably well guessed at, for the Park front may be taken as very nearly the same as that of the Reform Club-house, each having nine windows in breadth, and the proportions of the openings and spaces between them appearing nearly the same in each case. At any rate the difference cannot be much either way, consequently the South front of Bridgewater House, will be to that of the Reform Club as 15 to 9; or we may compute its extent at 190 feet, more or less.

It will be said—we have, in fact, said as much already ourselves, that there is nothing very striking either in the individual portions of this design, or in their combination:—it is nothing more than an excellent application of a good Italian style—absolutely nothing more. But then there is this difference, and a most prodigious one it is, between Mr. Barry's imitations and those of many others—see for instance a lately built façade in Regent Street,—that he generally refines and ennobles the style, and gives us its true sentiment, while they, more frequently than not, absolutely vulgarize it, and render it poor and insipid. If Mr. Barry's principle of composition is no secret to them, why do they abstain from making use of it themselves? It is true, not every one has the same opportunities afforded him, but even those who have favourable opportunities do not turn them to the best account—often throw them quite away, giving us the crassest architectural crudities. We own that Barry has here had a most noble opportunity put in his way; and should the design be strictly followed out—at any rate not impaired by being *pared* down, we may safely predict that it will prove a splendid addition to our metropolitan architecture; and we further trust will be an example forming an epoch in it, by stimulating others of the nobility to imitate such precedent;—whereas hitherto there has been some sort of excuse for their choosing to keep their houses as plain and as homespun in appearance as possible, lest while seeking gala suits for them, they should be imposed upon by such rascally Monmouth-street finery as that in which the Regent Park terraces, and other similar accumulations of architectural Brummagen, tawdriness and vulgarity, are bedizened out, till they almost look like so many regiments of ginshops.

We must pull up and rein in our Pegasus, for we are now got we know not where,—among Charles Barry's antipodes,—the ultra-cockneyfications of people who build by wholesale,—how unlucky that they do not also build for exportation only!—Quiet! Pegasus, quiet! dont kick. We notice some monstrosities of the kind on the walls of the Academy—as when do we not. Nevertheless we will not notice them further at present; therefore give them a chance of escape.

Instead of proceeding methodically, according to the order of the catalogue, we plunge *in medias res*, and turn to No. 1006, Mr. H. L. Elmes' Design for St. George's Hall, Liverpool, which certainly satisfies us much better than did any of the drawings for the same subject, exhibited last year. To say the truth, it is much superior to the general run of our Anglo-Grecian architecture, in which there is nothing Grecian except the columns alone, while here there is some taste, and some study shown as to the other parts. The solid, but ornamental stylobate, enriched with a narrow panel with figures in relief, is good and effective, and some play is produced by the entrances being made separate compositions at the extremity of this stylobate; but we do not understand why instead of being continued throughout, the panel should be divided into two by a blank space forming a break in the centre of the stylobate. The order is a fluted Ionic, forming an advanced colonnade of thirteen intercolumns, containing as many windows, which besides exhibiting considerable novelty as to the pattern of their glazing, are more than usually decorated, and have cornices of peculiar design, crowned by a central ornament—a novelty that deserves to be encouraged, though the form itself might be improved upon. The cornice of the order is also better, because less meagre and insipid than usual, and possessing some degree of embellishment. Thus far we can conscientiously commend—and though it may stand for nothing, our commendation means something; but we must also qualify our praise by some objections, one of which is that the colonnade appears so shallow, as to be little more than an ornamental range of columns placed before the building, nor does there seem to be any entrance to it from the interior. Neither do we at all approve of a colonnade of this kind being made prostyle or jutting out from the building, as if it were a portico forming the approach to it; because it looks too much like a mere useless addition to it, nor is that effect of shadow obtained which is produced by recessing the space behind the columns within the building. However from a perspective elevation alone it is impossible for us to judge very accurately in regard to such circumstances. His other design, for the Law Courts, turns out much better than we expected, for when we first heard that its chief feature was a Grecian Doric portico, we were apprehensive that it would prove merely one of those ultra-Grecian affairs concocted according to recipe à la Stuart, in short some such *regularly* classical piece of design as the New Liverpool Custom-house. We were therefore agreeably surprised at finding it so very much better, and with more than usual taste as to composition, and study as to detail, in which last respect there is one rather happy novelty in the mode—not easy to be plainly described—in which the podium and its mouldings follows the curve of the columns, and form what may be considered either continuations of their shafts, or distinct pedestals, by the podium itself being omitted in the intercolumns beneath the pediment. The general design may be described as consisting of five compartments, viz., a narrow one at each end between antæ, and three others making altogether seventeen open intercolumns, five of which form the slightly advanced central division beneath the pediment; consequently the arrangement of the whole façade bears so far considerable resemblance to that of the Fitzwilliam Museum, at Cambridge. The whole is raised on a low stylobate, and the ascent to the portico is tastefully managed. The pediment is filled with bas-relief.*

Good as the preceding design is, there is far more of originality, both as to conception and treatment, in No. 998, (E. B. Lamb,) for the same building, described in the catalogue as being in an Italo-Grecian style, to which designation it answers sufficiently correctly, being for the most part Grecian in its physiognomy,—in the regularity and richness of its columniation,—but relieved from Grecian monotony by some judicious modifications, and by some application of Italian features. Leaving others to settle whether such style would best be turned Grecian *Italianized*, or Italian *Grecianized*, we will examine the merits of the design itself. The order which is Ionic, is raised upon a somewhat lofty stylobate, or rather, basement floor, and is carried uninterruptedly throughout the whole façade, so as to form an open colonnade of 15 intercolumns, and a closed compartment at each extremity between bold coupled antæ. This last circumstance gives additional value to the rest,—for those parts contribute materially to breadth and repose, while they are far more important in themselves than had there been merely two antæ and the space of an intercolumn between them. At the same time that greater contrast is thus obtained, a pleasing degree of uniformity has also been kept up, and this has been accomplished in a manner as effective and tasteful as it is novel, viz., by recessing the upper part of the wall between the antæ, so

* We have been informed that this design is almost identically the same with that by Barry for the Law Courts, proposed to be erected in Lincoln's Inn Fields. We greatly doubt, however, if such be the case, except, as far as the general arrangement goes; for if the peculiarity above pointed out, with regard to the columns, be the same in both instances, it would be a very remarkable coincidence indeed.

as to admit of a large statue being there placed at each end, and which of course becomes strongly relieved by the mass of shadow surrounding it. This may so far not be Grecian, because there is no direct authority for it, but then it is on that account all the more meritorious, because it is most certainly, both Grecian and classical, in sentiment. Similar in character to the parts just described, but with some variations, owing to their being more extended, are the elevations of the ends of the building, so that the whole is in keeping throughout; which we are sorry to observe is a much greater and rarer merit than it ought to be,—certainly one that has been utterly disregarded by the classical architect of the Post Office. Among other points that particularly recommend this design of Mr. L.'s, is that he has kept up or rather enhanced the dignity of the colonnade, in the first place by introducing inner columns in the part serving as a vestibule between the two courts, and in the next by avoiding windows, and making the two doors seen behind the columns very conspicuous and highly ornamental features. There is also much that is equally good and new in the details of the order itself,—in the capitals especially, and likewise in the cornice.

(To be continued.)

ENGINEERING WORKS OF THE ANCIENTS, No. 5.

THUCYDIDES, who wrote about the year 400 B.C., is the next whom we shall take in our discursive course; his history however presents few gleanings.

WALLS OF ATHENS.

About 481 B.C., the Athenians restored their dismantled walls, and also enclosed the Piræus.* From political circumstances the works were very much hurried, the foundations were laid with stones of all sorts and sizes, some unwrought, and just as they were brought up by the servers. Many pillars too from sepulchral monuments, and other wrought stones were worked up in the building; for the boundary wall of the city was now far greater, being in every direction carried out; and for this reason it was that they urged on the work, employing alike whatever came to hand. It was Themistocles, too, who persuaded them to build the remaining walls of the Piræus (for this had been begun by him during the year of the archonship which he filled at Athens), thinking the place highly favourable, as having three natural ports, and that as they had become a nautical people, it would much contribute to their obtaining naval power. Indeed he first ventured to tell them they should apply to the sea, and then immediately assisted them in acquiring the empire of it. By his counsel it was that they built the wall of that thickness about Piræus; for two wains brought stone, passing by each other upon it, and going contrary ways. Within, there was neither rubble nor clay, but the stones were large and hewn square, fitted together in building; and those on the outside bound together with stone and lead. The height however was only finished to about the half what was designed, for his intention was to effectually repel all hostile attacks, both by the thickness and the loftiness of the walls, and he thought that thus a few, and those the least effective persons, would be sufficient to man it, and that the rest might embark on board the fleet: for he chiefly devoted his attention to the shipping, perceiving, it seems, that there was a readier access for the king's (Persia's) forces against them by sea than by land. For he judged that the Piræus would be more serviceable than the upper city, and often counselled the Athenians that if ever they should be foiled by land, they should descend thereto, and with the navy make head against all opponents.

Frequent mention is made in other places of walls of defence and offence, but these do not present sufficient general interest to call for particular notice.

The Athenians, as we shall hereafter have occasion to mention were distinguished as engineers, and particularly skilful in constructions of this kind. On account of the peculiar mode of building, workmen were employed who were skilled in this iron cramping.† Thus we find that to the seige of Nisæa were sent iron and stone-masons.

MINES.

Although Thucydides was himself a proprietor of mines, we find very few and short notices in his work. In the First Book chapter 100, allusion is made to a mine in Thrace, of which mention is made by no other author. In the Second Book, chapter 55, our author recounts that the Peloponnesians, having devastated the champaign country of Athens, passed into what is called the territory of Paralus, as far as Laurium, where were the Athenian silver mines, to which however they appear to have done no injury. The gold mines near Thrace were possessed by Thucydides,* and are supposed by the commentators to have been situated at Mount Pangæus, and to have been the same from which Philip, King of Macedon, derived the funds which enabled him to conquer Greece.

ATHENIAN ENGINEERS.

The reputation of the Athenians as engineers is attested by Thucydides in the following passage.† The Lacedemonians as their war against the rebels in Ithome ran out into a length of time, demanded the assistance of the allies, and amongst others of the Athenians. No small number of these were sent to their aid under the command of Cymon. The demand of assistance from them was principally owing to the reputation they then were in for their superior skill in the methods of approaching and attacking walls.

VALUE OF WROUGHT MATERIALS.

Another of those circumstances which attest the value of manual labour among the Greeks, we find in the Second Book, in the account of the preparations made by the Athenians for sustaining a siege during the Peloponnesian war, when they removed into the city not only their moveable property, but even much of the woodwork of their houses.

CONDUIT AT ATHENS.

Thucydides (Book Second), mentions at Athens a conduit called the Enneakrounos or Kine Pipe, from the manner in which it was embellished by the tyrants, formerly called Callirhoe.

SIEGES.

The sieges described in this history do not well come within our sphere, but those who are desirous of ascertaining the resources of Greek military engineering, will do well to refer to them, particularly to the siege of Platea. Here we find mining, countermining, raising mounds, walls of circumvallation, &c.

BRIDGE OVER THE STRYMON.

In the Eighth Book we find the bridge over the Strymon, mentioned by other authors referred to.

PERSIANS.

DIVERTING RIVERS.

We find in Thucydides one solitary mention of the Persians, and that with regard to the art in which they excelled, hydraulic engineering. Megabyzus, the son of Zepyrus, commanding the Persian forces in Egypt, having driven the Greeks out of Memphis, drove them into the isle of Prosopis, where he shut them up. Here he kept them blocked up for a year and six months; till having drained the channel, by turning the water into a different course; he stranded all their ships, and rendered the island almost continent. He then marched his troops across, and took the place by a land assault.

Diodorus the Sicilian, was the author of a general history called the Historical Library; he flourished in the first century before the Christian era. The first of our gleanings from the translation of his work by Booth, relates to the Egyptians, who are treated of in the First Book.

EGYPTIANS.

HONOURS PAID TO ENGINEERING.

All writers in Egypt attest the honour in which the Egyptians held the construction of public works, many of their oldest monuments being attributed to the gods. The god Osiris, by some is named as the founder of Thebes, and he made an expedition through the world for the purpose of introducing civilization, during which he built several stately cities, particularly in Ethiopia and India. In enumerating the merits of the kings, our author says, "And besides all this, were conquerors of many nations, and grew exceeding rich, and their provinces were beautified with many stately magnificent works, and their cities adorned with many rich gifts of all sorts."

EMBANKMENT OF THE NILE.—HERCULES AND OSIRIS ENGINEERS.

In the time of Osiris, the Nile is reported to have broken its banks, and overflowed the greater part of Egypt. On this occasion the old or Egyptian Hercules, who, says our author, was always for old and difficult enterprises, and ever of a stout spirit, presently made up the breaches, turned the river into its channel, and kept it within its ancient banks; and therefore some of the Greek poets, from this fact, forged a fable, that Hercules killed the eagle that fed upon the heart of

* Book 1. ch. 93. † Book 4. ch. 69.

* Book 4. ch 106. † Book 1. ch. 11.

Prometheus. The most ancient name of the river was Oceames, which in the Greek pronunciation was Oceanus, afterwards called Eagle, upon the violent eruption which covered a great part of the province governed by Prometheus, in consequence of which he died of grief.

What Hercules did for the lower part of the Nile, Osiris did for the upper part of the same river, for having come to the borders of Ethiopia, he raised high banks on either side of the river, lest in the time of its inundation it should overflow the country more than was convenient, and make it marsh and boggy; and made floodgates to let in the water by degrees as was necessary.

Uchoreus, whom Diodorus calls the builder of Memphis, thus managed the site he had chosen. The Nile flowing round the city, and at the time of the inundation covering all round on the south side, he cast up a mighty rampart of earth, both for a defence to the city against the raging of the river, and as a bulwark against an enemy by land; on every side likewise he dug a broad and deep trench, which received the violent surges of the river, and filled every place round the rampart with water, which fortified the city to admiration.

We here find Osiris, the chief god of the Egyptians, and Hercules enrolled among the patrons of engineering, so that when the profession is driven to a pinch for an emblem, here is the *deus ex machina*. Hercules destroying the eagle preying on the vitals of Prometheus, will make a pretty device either on a medal or on a service of plate presented to a member of the profession.

EMBANKMENTS OF SESOSTRIS.

Sesostris on his return from his warlike expeditions applied himself like his predecessors to the adornment of his country. Among his other labours are mentioned that he raised many mounds and banks of earth, to which he removed all the cities that lay low and in the plain.

CANAL OF THE RED SEA.

The following is the account which our author gives of the famous canal of the Red Sea. From Pelusiacum as far as to the Arabian Gulf, and the Red Sea is a canal cut out. Necos, the son of Psameticus, was the first who began this work, and after him Darius the Persian carried it on, but left it unfinished, being told by some that if he cut it through the isthmus all Egypt would be drowned, for that the Red Sea lay higher than Egypt. The last attempt was made by Ptolemy the Second, who cut a sluice across the isthmus in a more convenient place, which he opened, when he had a mind to sail down that way, and then presently after shut up again; which contrivance proved very useful and serviceable. The river which runs through this cut is called Ptolemy, after the name of its maker. Where it falls into the sea, there is a city built called Arsinoe.

According to Diodorus, Nile, King of Egypt, called the river after his own name. For being that he cut many canals and dikes in convenient places, and used his utmost endeavour to make the river more useful and serviceable, it was therefore called Nile.

Sesostris also cut a great many deep dykes, or canals from the river, all along as far from Memphis to the sea, for the ready and quick conveying of corn and other provision and merchandise, by short cuts thither, for the support of trade and commerce, and maintenance of peace and plenty all over the country. These canals served also as defences.

COCHLIA.

Our authors say that the land was watered from the canals by means of a certain engine, invented by Archimedes the Syracusan, and which received its name from its resemblance to a snail's shell.

LAKE OF MERIS AND THE LABYRINTH.

So much distrust has been thrown on the account of the Lake of Meris, that we think it better to refer those of our readers, who are desirous of obtaining information respecting it to the original, rather than give it here.—The same remark we must make with regard to the Labyrinth.

WALL OF SESOSTRIS.

Sesostris is recorded as having built a wall for the defence of the east side of Egypt, against the irruptions of the Syrians and Arabians. This wall is stated to have extended from Pelusium through the deserts as far as Heliopolis, and to have been fifteen hundred furlongs, or about two hundred miles in length.

PYRAMIDS.

The Pyramids and Obelisks are works certainly belonging to engineering, but as it is our object rather to show the bearing which ancient history has upon the practice of the art in modern times, than to elucidate subjects, which more properly belong to the province of the antiquarian, we content ourselves with reminding our readers, that in the author before us they will find much information with regard to these splendid works of art.

GEOMETRY.

The priests were the instructors of youth, and the learning taught by them was called sacred. In arithmetic and geometry, even in the time of our author, they kept the students a long time.

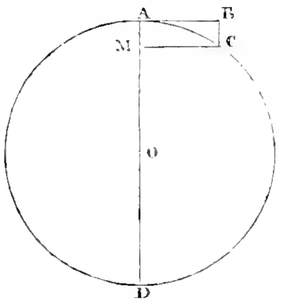
(To be continued.)

ON THE ACTION OF CENTRAL FORCES.

"Happy is the man who can discover the causes of things."

Sir—In the number for April last, there is inserted a paper on central forces, in which the writer endeavours to prove the existence of "an inscrutable law of nature," according to which centrifugal force is excited by the curvilinear motion of a heavy body.

Before offering remarks on that paper, let us first inquire into the distinct action of the forces that retain a heavy body in a circular path.



Taking the usual diagram, let A C D be a circle of revolution, A C any very small part of it, A O D the diameter at the point A, and B M the rectangle on the diagonal A C. Then A M is the effect of central attraction on the body at A, and A B its projectile motion. The motion in A M is accelerative, being originated from nothing by central pressure. The motion in A B is uniform, being the result of an impetus previously communicated. Now the ratio of A M to A B may be diminished to any extent, by diminishing A C. For $AB^2 = AM . MD$, and therefore $AB : MD :: AM : AB$. Now, in reducing A C we reduce A B also, and the less we make A B, the less is its ratio to M D or A D, and the less also is the ratio of A M to A B; and this ratio may thus be diminished to any extent. Thus, also, the circular motion may be considered ultimately, when A B becomes indefinitely small, to be composed of projectile motion and incessant central pressure. Again, $AC^2 = AD . AM$, and $AB^2 = DM . AM$, therefore $AC^2 - AB^2 = AM . (AD - DM) = AM^2$. But it appears that this difference may ultimately be neglected; therefore $AB = AC$ ultimately. But A C will be the momentary projectile motion of the body when arrived at C, and therefore, as the other circumstances of motion are the same as at point A the new resultant and consequently, also the new projectile motion $= AC = AB$. This proof holds good at every other point, and therefore the motion in the circle must be uniform, and equal to the original projectile motion.

To proceed; the writer begins with a familiar example of rotatory motion in the operation of electro-magnetic attraction upon a projected bar of iron. He says that its motion in the circle is uniform, because the deflecting and projectile forces do not influence one another, being independent of each other, and acting at right angles. Now, certainly they are independent as to origin, for the bar would adhere to the magnet, though it moved not at all. But the deflecting force is dependent in respect of *quantity* upon the other. We cannot certainly say that the whole power of attraction is deflecting force, though the writer says so expressly in another part of his paper, page 115. On this supposition we might make the deflecting force as strong as we please, other circumstances being identical; which is absurd, and would, if true, overturn entirely our mathematical demonstrations on the subject, including propositions of which he himself makes use. In fact, magnetic attraction may be much greater than is necessary for that purpose. The deflecting force, then, strictly so called, is just so much of the attractive force as is necessary for deflection, the overplus being superfluous pressure. Respecting their action at right angles, I have already shown, that the deflecting force greatly influences the projectile. In fact it perpetually combines with it, and produces resultants equal to one another, and to the projectile motion. *This* is the reason of the constancy of circular motion.*

Mystifying the origin of centrifugal force, he says that as it is equal and opposite to the centripetal force, it cannot arise from the magnetic

* He says again, the centrifugal force cannot be the resultant of the other two forces, for it would then point within the circle. This contradicts the very definition of circular motion, which is that the resultant is neither within nor without, but *in* the circle.

action. Certainly not from the overplus action, but undoubtedly from the deflecting magnetic action, for it is evidently just a case of the third law of motion; that action and reaction are equal and contrary: a very satisfactory explanation, yet what an effort is made to obscure the subject!*

The writer now drives the apparatus with a winch, and supposes the magnetic attraction to perform the business of cohesion, and then asks if his hand imparts the centrifugal force. This requires no answer from me, and he has thought fit not to do so either.

His illustration in the case of a sling, I confess I understand not. It involves the absurdity of expressing velocity in terms of weight; although, as I understand it, it ought to be told in terms of space and time.

The instance of the fly-wheel has little new, except the manifestation of another misconception of the writer's. "The central (centrifugal) force, says he, acts by pressure, and a resultant from that pressure and the force in the circle is the consequence, but so long as resistance from cohesion continues, neither motion nor pressure can be imparted to another body by the central force." The writer here exchanges cause and effect, for he would fain attribute a self-exciting property to the centrifugal force, and insinuates accordingly that the resistance of cohesion is the *consequent* centripetal force. Whereas the reverse is the case; the cohesion is exerted, because it perpetually winds the direction of projectile motion; and the centrifugal force is plainly the *inertitic* (forgive the innovation) tendency of the body to rectilinear motion. There is also something said of moment of rotation, irrelevant to the subject.

The experiment of the whirling table simply confirms what was proved long ago, that, using the writer's symbols, $x = \frac{v^2}{r}$.

After recapitulation, he concludes the first part of the subject with the notable inference, that centrifugal force is a physical agent, excited by an inscrutable law of nature when matter moves curvilinearly. I need not say how unnecessarily this law has been brought forward. It really would be more surprising than the formation of magnets by electric operations. For electricity and magnetism are identical, and therefore naturally enough such a result should take place. Though we may not know the absolute nature of physical principles, we may accurately know their relative nature. Therefore the writer is unfortunate in his allusion, as we are dealing in relatives, not in absolutes.

Proceed we to the second part of the subject: the composition of the projectile and centrifugal forces. And here an absurdity at once presents itself. We are told that a ball weighing 1 lb. moving in a circle of 2 feet radius, at the rate of two revolutions per second, has a projectile velocity of 25·14 per second, and a centrifugal velocity of 157·76 per second. This number has evidently been the result of the formula $\frac{v^2}{2r}$, which expresses the proposition quoted from Brewster's Encyclopedia. For $\frac{25 \cdot 14^2}{4} = 157 \cdot 76$ feet. Now, it is a misnomer to call this the velocity per second. It is the space passed through in a second by the body, with a motion accelerated from nothing. We might as well say that $\frac{157 \cdot 76}{2} = 78 \cdot 88$ feet would be the space passed through per half second. But what would the rule give us? The projectile velocity per half second being 12·57, we would have by the rule $\frac{v^2}{2r} = \frac{12 \cdot 57^2}{4} = 39 \cdot 44$ feet per half second: ludicrously inconsistent. The writer places the two forces on the same footing, whereas the one is impulse, the other pressure; which renders the succeeding reasoning a baseless fabric. I have shown at the commencement of this paper, which I fear is too long, that the shorter the time supposed for action, the less is the ratio of the effects of the projectile and centripetal forces, and therefore in any moment of time, the effect of the latter is unassignably less than that of the former. If he will turn also to Cavallo, whom he has so often quoted, he will find the same conclusion come to in his third proposition on curvilinear motion.

The experiment with the tube and balls, though it has the appearance of accuracy, is undoubtedly pointless. The apparatus must have been exceedingly clumsy to require "very high increasing velocities" to manifest the action of this wonderful power.

"As to the probable results of a practical application of this principle," they will be exactly nothing at all, as the experiment with the tube and balls well nigh proves.

I am, Sir, your obedient servant,

DANIEL CLARK.

Phœnix Iron Works,
Glasgow, May 10, 1841.

* The idea of the perpendicularity of their directions preventing their mutual action is very absurd. What is parabolic motion?

ON THE EMPLOYMENT OF MILITARY ENGINEERS.

SIR—In your last month's Journal, under the above head, I find an attack made on military engineers and military engineering, as uncalled for and unprovoked, as it is narrow-minded, illiberal, and ungentlemanly, and I am sure that from a sense of justice you will insert these few remarks in reply to the anonymous libeller who signs himself "Civilian."

The purport of the writer is an evident desire of venting his petty spleen on a body of talented, high-minded, and honourable men, and whilst I much regret that your columns have been made use of for the purpose of libelling a "Captain of engineers at the head of the architectural and engineering departments of the Admiralty," viz. Captain Brandreth—a gentleman whose talents, urbanity and kindness have endeared him and made him respected by all who have been connected with him in his professional capacity—I am sure that no civil engineer laying the slightest claim to station, to gentlemanly feeling, or to respectability, would ever descend to such low personalities, nor will "Civilian" ever obtain the sanction or countenance of such men to his vituperations.

If "Civilian" had the benefit and the interest of the civil engineer at heart, he would never for a moment wish to weaken the union which is now daily increasing between the civil and the military engineer, for their mutual as well as for the public good. The spheres of action of the two professions lie in almost every case so widely apart that they may be said never to clash; while the foreign services of the military engineer open to him a vast field of inquiry and information, which those who practice in this country as civilians are unable to obtain. His varied information, his experience, strength of mind, and coolness for calculation, fully entitle him to such offices as the country is able to give; and in *justly* awarding the few she does to him, she but acts for her own interest.

With respect to young gentlemen who are educated at the military colleges—is "Civilian" aware of the rigid examination these gentlemen have to pass through before they are entered into the corps of engineers? and that but a very small number are admitted into *that* corps every year? Is he also aware of the number of young gentlemen who are annually sent out of engineers' offices, after spending, as "Civilian" boasts, "nearly £1000," is he aware that *they* are sent out without *any examination*, and in most cases with a meagre knowledge picked up in the best way they are able, and not "drilled under the auspices of their colonel"—would they had been! And why, I would ask, are men of talent, of exertion, of experience, not to practice in the varied callings of their profession, if they so please, if they are competent, and if the public will employ them?

I am a civil engineer myself, which fact I doubt of "Civilian," indeed I would not, for the credit and the respectability of the profession, believe he ranked himself as one, as no man holding any station in it, much less having any respect for himself, would be the author of such a production.

I am, Sir,
Your obedient servant,

Bristol. VERITAS.

SLATE CHIMNIES.

SIR—Having lately adopted a plan, by means of which slate slabs may be made use of, in the construction of chimneys or flues, in connexion with an open fire grate, and in situations where the common brick chimneys could not be built, I take the liberty of submitting the plan to your consideration.

Having not long ago taken possession of a house, attached to which was a room built at the side, and not having fire place and chimney I adopted the following plan:—I fixed to one of the walls of the room, at a proper height from the floor, a common open fire-basket or grate, having a strong iron back, not let into the wall, but fixed in front of it. I then had four long narrow slate slabs put together, so as to form a square hollow pillar open at top and bottom, and the pillar so formed I had erected against the wall immediately over the fire-grate, and carried the pillar out through the ceiling and roof of the room. The fire-grate and flue thus enclosed, had a chimney-piece of slate set to correspond. The slate, not being so good a conductor of heat as iron, does not give out any thing like the same quantity of heat an iron pillar or pipe would have done; at the same time the heated air, passing up through the slate pillar imparts to it such a degree of heat, as adds very perceptibly, and I may add very pleasantly, to the warmth of the room. The Welch slate, as is well known, will crack* on being exposed to a very slight degree of heat, but my slabs were made of Valencia slate (from quarries in Ireland), which do stand heat very well, if cautiously applied in the first instance.

The superficial quantity of slate used was very small, the slabs being very narrow, consequently the expense was very trifling. The economy of heat I consider to be no small advantage in my plan. In the case of a common brick chimney let into the wall, the heated air passes up it, imparting no heat to the room, but in the case of this slate pillar, erected *within* the room, the heated air passing up through it, is conducted by means of the slate into the room. Indeed it was found that the warmth of the room was fully maintained with a very small consumption of fuel.

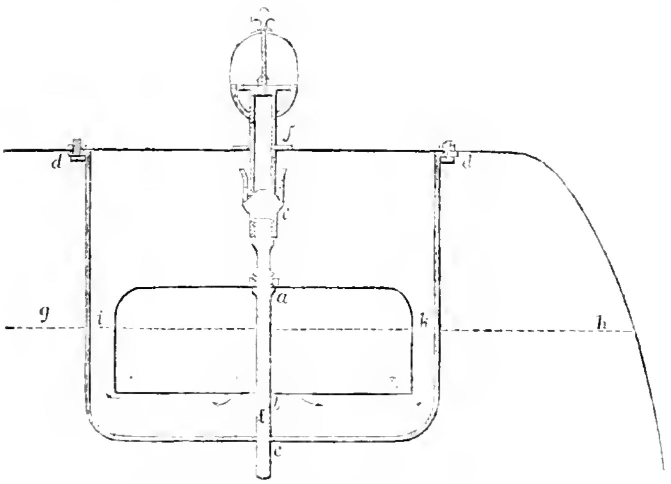
Should you deem this little plan worthy of being brought to the notice of your architectural friends through the medium of your valuable Journal, it will much oblige, Sir,

Your obedient humble servant,

London, May 6. A Lover of the Fireside.

ALARUM WHISTLE FOR STEAM BOILERS.

Sir—The enclosed sketch represents, in section, a simplified form of alarum whistle for steam boilers which has occurred to me. Should you deem it worthy of insertion, you will perhaps give it a place in your valuable pages.



a, i, k, b, is a float, which consists of an inverted vessel of sheet iron or other metal, through the centre of which passes a spindle *a c*, having a collar at *a*, upon which the float is screwed down by a nut outside. At the upper end *e* is fixed a cap of brass with a joint ground steam-tight to the bottom of the whistle *f*; *d c d* is a stay through which the spindle *a c* passes, having sufficient clearance in the hole at *c*. This stay may be either double, as shown, or single. At *b* is a cotter which prevents the spindle dropping farther than the distance from the bottom of the cotter to the stay at *c*; *g h* is the surface of the water.

When the steam is down, the cotter in the spindle rests upon the stay, through which the spindle passes leaving the passage at *e* open. As soon as the steam rises, the vessel *i a k b* fills with steam and rises to the position shown in the sketch. When the water falls the float also falls, leaving the passage to the whistle open, and is stopped in its descent, as above described, by the cotter *b* resting on the stay. There are holes at the sides of the cup *e* as well as a passage through the top to prevent the lodgment of dirt, &c.

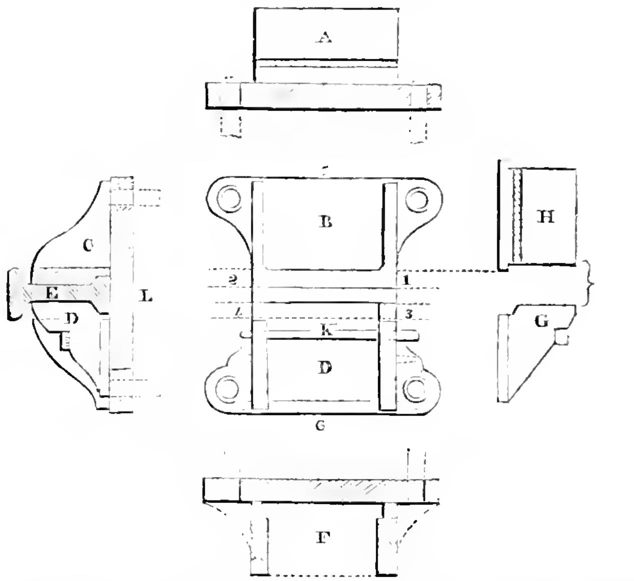
The advantage which I think this apparatus possesses above any I have yet seen, is the absence of any working joints, there being only two points of contact required, at *e* and *c*, and those leaving clearance. The whistle will also act as a vacuum valve when the steam goes down; for it is evident that when the steam is below the pressure of the atmosphere, it will be condensed in the float vessel, which will consequently fall by its own gravity.

I am, Sir,

Your's obediently,

Liverpool, May 15. G. J. Horner.

NORTH OF ENGLAND RAILWAY CHAIR.



A, section from 1 to 2.—B, plan of chair.—C, section from 5 to 6.—D, ditto, locking cheek in its place.—E, ditto, rail.—F, ditto, from 3 to 4.—G and H, side and end of locking cheek.—K, malleable iron key or wedge.—L, stone blocks, or wood sleepers.

Sir—I beg to hand you a sketch of a joint chair with some explanation, &c., and a section of the rail used on the Great North of England Railway, which are at your service. The chair is considered to be well adapted to the rail, and simple in its principle. The middle chair, as well as the cheek chairs, are on the same construction, but vary in the weight:

Joint chair	40 lb.
Middle do.	41
Cheek do.	30
Rail per yard lineal	60

The railway has now been opened since the beginning of last April, and keeps in a good working condition, there are very few slips or subsidence in any of the embankments or cuttings. From the easy gradients, solidity of execution, and other favourable features connected with the Great North of England Railway, it readily may be inferred that the line will be worked at less cost than any other line of the same extent.

I am, Sir,

Your obedient servant,

York, May 12. M. Q.

GREENWICH RAILWAY.

List of tenders of the third contract for widening the railway between the London terminus and the Croydon Junction, delivered in on the 27th April last.

Mr. Jackson	£11,608
Messrs. Ward	11,892
Mr. Grimsdell....................	11,947
Messrs. Grissell and Peto	12,275
Mr. Bennett	12,350
Messrs. Baker....................	12,380
Messrs. Little....................	12,406
Messrs. Lee......................	13,333
Mr. Mundy	13,528
Messrs. Piper	13,650

* Some qualities will stand the fire remarkably well.—Ed.

NEW AND USEFUL INVENTIONS.—No. 4.

By Philotechnicos.

PIMLICO SLATE WORKS, UPPER BELGRAVE PLACE.

These works have been lately erected for the purpose of sawing, planing, moulding, and turning slate by machinery worked by steam power, for the manufacture of a great variety of useful and ornamental articles. The slabs are distinguished by their ebon-like appearance and freedom from green spots or stains. They are produced from the proprietor's own quarries in North Wales, where they have extensive machinery worked by water power, and from whence the slabs are forwarded, roughly planed: they are here finished in various ways; the roughly planed are used for paving, wine binns, cisterns, covering, and common purposes, the smoothly planed for sinks, mangers, and shelves for larders and dairies. The snaked or finely rubbed for bettermost purposes of the same description, chimney pieces, hearths, baths, skirting and sideboards, and when oiled have the appearance of black marble. The next and most beautiful state in which the slate slab is used is when japanned; by this process it is subjected to great heat, which leaves on its surface a permanent polish, and is used for decorative purposes as a general substitute for marble or scagliola, and a most excellent substitute it is, being of a hard close texture it bears a sharp arris and brilliant polish, and one of its greatest advantages is cheapness.

Chimney pieces are made to any design, and their manufacture at this establishment forms one of the most useful applications of slate for building purposes; the imitations of conglomerate marbles are matchless, and the correctness with which machinery performs its duty is strikingly exemplified in every part of the work. I sincerely hope this invention will induce architects to introduce marbled slate chimney pieces in every place where the common-looking Portland is now used, to which material it is so superior that there is no comparison with regard to appearance, and is but little more in cost.

Sideboards, tables, cheffoniers, and other articles of furniture are likewise manufactured with the japanned and marbled slate, in the panels of which are occasionally introduced beautifully executed paintings, similar in appearance to those on papier mâché. A billiard table has been constructed at this manufactory, the whole of which, frame, bed and legs, is of slate; the legs are massive, and show the capability of slate for purposes of support.

For culinary purposes slate is particularly applicable from its cleanliness, the closeness of its texture preventing the possibility of imbibing any thing offensive, and requires only to be occasionally cleaned with soap and flannel to remove any impurities; it is consequently well adapted for sinks, shelves for larders, meat safes, and dairies, paste or butter slabs, salting vats, and many other purposes where a cool and clean material is required.

In the laundry it is useful for ironing tables, clothes presses, and mangles, the smooth and hard surface of the slate rendering the clothes subjected to its pressure nearly equal in appearance to their having been calendered.

Shops may be elegantly ornamented with slate, both internally and externally. In the shop front a brilliant effect might be produced by its introduction, with the advantage over marble of its retaining the polish after exposure to the weather; for counter tops and fronts and show tables a novel and pleasing effect may be produced, particularly in confectioners' and chemists' shops, taverns, railway refreshment rooms, and other places of public resort.

Stables fitted up with slate will have the advantage of superior cleanliness to any other material, its non-absorbent qualities preventing infection, and its hardness being an antidote to crib biting; the mangers, stalls, linings, and capping can be made of slate, as well as the corn-binn, which latter, being made with a sliding cover, and wholly composed of slate, is most useful, as being cool, cleanly, and proof against vermin.

Fire-proof buildings may be constructed with the greatest facility by the introduction of slate for the floors, skirtings, stairs, doors, and window frames. The drying-rooms, or, as they may be almost termed, the ovens, at this establishment, are composed principally of slate; the floors, shelves, and sliding folding doors, running with rollers upon a railway, and roof, are of slate, and subjected to a high degree of temperature.

I must confess my surprise at often seeing buildings erected for the purpose of warehousing inflammable or other goods with timbered and boarded floors; it is an unpardonable oversight not to take advantage of the various kind of materials suitable to this purpose, adapting the material to its use, and the many calamitous fires that have lately occurred, prove too truly the want of this discrimination. I do not know any thing better than slate to serve this end; light iron joists covered with slate slabs will form an excellent floor or flat, sliding doors can be constructed on rollers, and the stairs made entirely of slate—here then will be a building perfectly fire-proof at but comparatively small cost, and yet how little slate is used for this purpose. I am most anxious to draw the attention of architects and engineers to this particular point, as it is one of their imperative duties, as far as it is compatible, to render any portion of the building they can, fire-proof, substituting slate for wood in every case where such can be done with advantage.

Balcony bottoms, steps, and such works as require lightness and strength, can be constructed of slate, as it is calculated to be five times stronger than stone, and is, when only self-faced, comparatively smooth, or can be moulded and rendered perfectly smooth by machinery where a high finish is required.

Having enumerated several of the many uses to which slate is applicable, I shall conclude with a strong recommendation to the profession to encourage its manufacture as a material entirely of home production, and one capable of much diversity.

[We have received the following communication, showing the strength of the above slate.—Editor.]

Sir—The following trial of the strength of slate in its capacity to resist pressure, may not be altogether uninteresting.

Having occasion to cover a subway of considerable length under a carriage road, and being desirous to use slate on account of its non-porosity, it became necessary to test its strength, and I procured a piece from the Pimlico slate-works about 5 ft. 6 in. long, 5½ in. wide, and nearly 2¼ in. thick, planed fair on both sides. Messrs. Bramah and Wool, of the Grosvenor Iron Works, kindly made the required experiment for me.

The ends of the slip of slate having been placed on supports 5 feet apart, it was loaded in a pyramidal form with ballast iron, the centre loading being about 3 ft. 6 in. high, and the sides from about one foot. When weighted with 1 ton 5 cwt. 3 qrs., the slip broke. I fancied that I could detect a very slight deflection when the last cwt. was added, but although I had a line stretched along the bottom edge of the slip, the deflection was hardly perceptible when it gave way.

Mr. Magnus, the proprietor of the works, thinks this hardly a fair test of what the slate would bear, its strength being much reduced by the planing, which intersects the natural laminæ of the slate.

Torrington Square, Your's, &c.,
May 19. Henry Robert Abraham.

BENEVOLENT INSTITUTION FOR MECHANICAL ENGINEERS.

We have long regretted in the great advance of the profession, that while it possesses so many excellent scientific institutions it possesses none of a benevolent character. We are well aware that attempts have been made to supply this want, and that the principal cause why such efforts have not succeeded is that the want of benevolent assistance has not been sufficiently felt. It would be a libel indeed on the profession to suppose that while its members are so liberal in encouraging the spread of science, and in educating successors and rivals to themselves, that they should from pecuniary motives be neglectful of the material interests of their fellows, that while providing for the mind they should be neglectful of the body. The cause and the only cause has been the one which we have assigned, but we think that it now becomes a matter of grave consideration, whether the same circumstances should still be allowed to have weight. We have reason to believe that as regards the higher branches of the profession, notwithstanding the hundred and fifty candidates the other day for the Chief Engineership of New Zealand, no serious pressure exists, but with the growth of the profession, and on its assuming a settled form we think it is incumbent on us to provide for the future. Further our pride is at stake, for our's is the only profession which is without institutions for the relief of its members, and while we have our universities, our colleges, and our institutes, we have no benevolent society. It may be a matter of gratification that we do not yet want it, but we must not be sure that this will long be the case, or that the *dura paupertas* will be long before it subjects us also to its harsh rule. It must also be borne in mind that if the higher branches do not imperatively require to unite for such a purpose on their own account, there are other classes connected with them the promotion of whose welfare is not less imperative. The workshops are crowded with hundreds of men, who although enjoying high wages, are too frequently from defective education, wasteful and improvident, and here we must pause for a minute to remind our friends of another duty, which they too often neglect—the education of his workmen is a duty, which the engineer thinks he has nothing to do with, he pays the man his wages, and there is an end of the matter, the master may go on in neglect, and the workman in vice, and few take the trouble to consider whether it really is of importance to them or no, whether the workman becomes an intelligent being or a besotted brute. Let those however who think so read the evidence of Mr. William Fairbairn, given last year before the Parliamentary Committee on the state of the working classes, and he will see that by following his worthy example that much is to be done that will bring its own reward. The educated workman may not become a more skilled mechanic, but he becomes a better servant, he knows his own interests better and those of his master, he is steadier, less given to combination and to strikes, and in the words of the Quaker cotton spinner, has a positive money superiority. The untaught man, however skilful, is too often the source of annoyance to himself and others, looking with ignorant jealousy on his employers, he is ever watchful against any fancied infringement of his rights, ready on any sudden turn to fall into the snare of combining to increase his wages, and however large these may be too often spending both his money and his time in sensual and debasing gratifications, without making any provision for the time when his strength and his youth no longer avail him. It is this latter circumstance which should direct our attention to do what we can for the improvement of the workman's understanding and his morals, and at the same time we should endeavour to retrieve the errors of the past by giving every assistance for the relief of the unfortunate. Urged by these motives many of the most eminent of the mechanical engineers have come to the determination of forming an institution for effecting the desired results by their own aid, and by the contributions of the workman, so that the operative will at last be enabled to make a provision for himself, his widow or his orphan. The workmen of Messrs. Maudslays have already held a meeting for this purpose. At the late anniversary of the Committee of Marine Engineers, it was proposed that some general measure should be adopted for extending the plan to all parties connected with mechanical engineering. A specific plan has not yet been adopted, but the following among others have given their sanction to the general principle, and have agreed to carry it out—Bryan Donkin, Esq., V.P., Inst. C.E., Messrs. Maudslay, Sons and Field, Messrs. Miller, Ravenhill and Co., Messrs. John Penn and Son, Messrs. John and Samuel Seaward, and Capel, Messrs. Fairbairn, Murray, and Hetherington, Messrs. John and Alfred Blyth, John Hague, Esq., James Simpson, Esq., and W. Simpson, Esq., &c. Under such auspices we trust that the proposed institution will be established, and as immediate steps are to be taken to carry it out, we anticipate soon to witness its beneficial effects. Having given this information to the profession, we shall make no application to them for support, as we are sure that they want no asking to use every exertion for so laudable a purpose. In the course of next month we hope the Society will be organized, and in the meanwhile we shall be happy to be the medium of any communications addressed to it through our office.

ARCHITECTURAL COMPETITION.

Brown v. Langshaw.

Sir—In consequence of the erroneous reports of this case in the Cambridge papers and elsewhere, and particularly the attack upon my professional character contained in a review in the last No. of "The Civil Engineer and Architect's Journal," it has become necessary in self-defence to publish a plain statement of the facts connected with the whole matter. Wrong conclusions ignorantly or designedly drawn from correct statements, may be safely left to the judgment and common sense of the public, but when injurious imputations and charges affecting one's reputation are founded on error or perversion, a man must set but little value on his character were he to suffer them to go forth uncontradicted and unrepelled. Such is my position, and I confess it is one in which I did not expect to be placed, through at least respectable organs, and after the acknowledgment openly made in court by his Lordship and the defendant's counsel, that my character was in no way impeached in the transaction. I will not occupy your valuable space, as I had intended, by specifically replying to the errors and falsehoods contained in the report given in your last month's Journal, but will at once proceed to sketch the principal facts of the case, in order that the public may see its merits and judge whether, instead of my having deceived and misled the committee, I have not been most harshly and unjustly treated throughout the matter, and greatly wronged by the incalculable result of the late action.

I forbear also expressly replying to the imputations and assertions founded upon the mis-statements to which I have alluded, as I consider it sufficient to disprove the premises on which they are based, and rely on that amends which those who have been led to circulate them will, as honourable men, I am sure, award me.

It was in February, 1837, that I received a letter from the Rev. George Langshaw (see letter A.) as chairman of the committee, inviting me to compete with Mr. Rickman, Mr. Poynter, Mr. Sharpe, and Mr. Walter of Cambridge, in furnishing plans for the intended new church there. Taking the cue from this letter, in which the defendant writes "we are anxious to accomplish something as worthy as possible of the example of former days, more especially as our church will stand in the middle of Cambridge, opposite Christ's College," and from his criticism, "I will candidly tell you that your new church at Stamford has pleased many here, though the *inside* has been thought not equal to the outside," I prepared a design in which the interior was rendered exceedingly rich and effective, and the exterior considerably more ornamental than the Stamford church.

The latter structure, built on a design somewhat similar, and so furnishing practical data to a considerable extent for my estimate was executed for £3,500. The amount of expenditure fixed upon for the Cambridge church was £4000 *and* £500 (the value of the materials of the old church), but towards the completion of my drawings I had some misgivings as to the possibility of executing the building for this amount, and upon making my estimate, these misgivings were confirmed.

In laying my drawings before the committee, therefore, I distinctly declined to undertake to carry the design into execution, as it then stood, for the £4,500, but explained that certain portions of the ornamental work could be omitted, without in the slightest degree affecting the integrity or general design of the buildings, so as to bring it within that sum. (See letter B.)*

What other course, let me ask, would any man, even of the most fastidious sense of honour and integrity, have had me pursue? the more especially when it was known that my drawings were not completed even until the day they were sent off to Cambridge.

In October following I received a letter from the defendant, informing me that my plans were preferred, and I shortly afterwards attended a meeting of the committee, and received instructions to make certain alterations in the ground and gallery plans, and to prepare two new perspective drawings of the exterior and interior denuded of the expensive ornamental work, and exhibiting the building in the state described in my letter.

The plans thus altered and those unaltered were then again submitted to the committee, and the whole were formally approved by receiving the defendant's signature.

At the preceding meeting, however, certain conditions had been drawn up by the committee in the shape of resolutions, the effect of which was that they might decline my plans altogether, if the tenders should exceed the amount of £4,500, and that in that event they should not be bound to make me any remuneration for my drawings and trouble, beyond what would be made to the unsuccessful competitors. To these conditions it was required that I should give my unqualified assent before my plans could be finally adopted; but to this I had strong objections, considering them, by their stringency, calculated to embarrass and prejudice me, but proposed to qualify the condition as to the rejection of my plans, by adding the words "if the excess of the tenders should not be sufficiently accounted for."

Whilst this was being debated, the committee instructed me to prepare drawings and estimates of transepts, school-room, crypt, &c., and make many other alterations.

I did so, and at last, upon being pressed for an assent to the conditions, and assured privately by the defendant that these terms were only imposed as a matter of business, and with no intention of taking any undue advantage of me, I was induced at last to give it. My plans were thereupon formally adopted, and I received instructions to prepare the working or contract drawings; this was in December, 1837. Bearing in mind the observations in Mr. Langshaw's first letter before alluded to, and moreover perceiving that on the part of the committee generally there was still an earnest desire to obtain a building of as ornate a character as possible, I was induced, in preparing the working drawings, to assimilate them very nearly to the more ornamental features of the original design, relying upon being able to obtain the consent of the committee to the condition that in case the tenders were in excess, I should then be allowed to reduce the working drawings of such ornamental work as would make them agree with the plans considered as adopted. The parish would thus have the *chance* of getting the church so built for the £4,500. I accordingly proceeded with and completed the working drawings pursuant to this

* We have not received this letter.—Editor.

arrangement, and not, it will be perceived, under the resolutions which embraced only the plans as adopted. I afterwards attended a meeting called for the express purpose of inspecting them, where they were *inspected, explained*, and *sanctioned*, so that there was here a formal assent given to them, and I was allowed to go for tenders upon them. For whose benefit was all this done? For my own it could not be; my commission would not have been increased, whilst it was likely my labour would be.

In November, 1838, four tenders were sent in. I wonder there were so many, considering the committee insisted, against my protest, and compelled me to advertize, that they "did not pledge themselves to accept the lowest tender," and that one of the members officiously informed several of the builders applying to inspect the working drawings, that "they need not tender unless they were prepared to build the church for £4,000," or to that effect. All the tenders were in excess, a probability which the very arrangement I made necessarily contemplated: and what then was the course this honourable committee adopted? Why this (one more notable for its brevity than its equity); the chairman called me before them, and read me a paper stating that the tenders were in excess, and that my plans were declined pursuant to the resolutions. Surprised at this laconic address and summary dismissal, after nearly two years' labour, with more than £200 out of pocket, and in the teeth of a special understanding, I appealed to the agreement, and offered to perform my undertaking; but the only answer vouchsafed me was, "we decline your plans," and this although I afterwards proferred to enter into a bond to find an unexceptionable builder to build the church for the £4,500. Thus I was shamefully shuffled off, and not even afforded the opportunity of making that adjustment between my plans and the tenders, for which I had expressly stipulated (although unfortunately not in *writing*). Had not this arrangement been previously sanctioned, I should not, of course, have ventured the plans for competition, except strictly in accordance with the resolutions.

This is my case, and although the law has enabled my opponents to triumph over me, yet I must contend that equity and justice are still on my side. How far the statements made in the article which has been chiefly instrumental in calling forth this, are consistent with truth, I must leave your readers to decide. I will but remark that my statement flatly contradicts almost every assertion advanced; 1st. that by which I am made to have professed myself "perfectly clear," that my design could be executed for £4,000 or even £4,500, sufficiently disproved by my first letter to the committee. 2ndly, the statements as to the proposed amount of expenditure, which was £4,500 instead of £4,000. 3rdly, the gratuitous assertion that the committee were "troubled with a prejudice," &c., when the fact was, that the "conditions" were imposed subsequently to the competition, and after my design had been preferred and accepted, notwithstanding the contents of the letter accompanying the drawings, by which I so fully explained how the matter stood. 4thly, as to the time I kept the action hanging over the heads of the committee, it was not "nearly *four* years," but only about *two*, and this through unavoidable circumstances. I will not swell a long letter with the detail of my offers to meet the committee, and enter into explanations of any possible misunderstanding, or to refer the matter to some disinterested party for arrangement, made first by myself and then through my attorneys, nor dwell upon the inference to be drawn of the committee's fearing to meet the truth, by their pertinacious refusal either to see or hear me, or listen in the slightest degree to any amicable proposition. It was thus, with the greatest reluctance and compelled by obstinate injustice, that I at last engaged in litigation; I must otherwise have quietly sat down under a gross injury, which neither suited my interest nor comported with my duty. Besides, in going to trial, I had a further object in view beyond gaining a verdict, and that was to bring as much of the merits of the case before the public as I could, in order that even had the jury found against me, the true cause of my dismissal might be clearly known, and the prejudice which that fact has produced be removed. But in this, also, I have been foiled by the judge's intention, who did not look beyond the resolutions, although the main points of all I have here stated were actually given in evidence; his lordship, as well as the defendant's counsel, nevertheless, doing me the justice in stating that my character was in no way impeached, even in their view of the case. My counsel's cross-examination of the defendant's witnesses, and right to comment on the whole case, and extricate it from the mystifications of my opponents, was thus stopt, the jury deprived of the power of giving *their* verdict, and my case prevented from having a trial. The only course left me was, therefore, to elect to be non-suited, reserving to myself the power of enforcing my right in such manner as may be most expedient.

Norwich, May 21. I am, Sir, your obedient servant,
John Brown.

Letter A.

To — Brown, Esq., Architect, Norwich.

St. John's College, Cambridge, February 22nd, 1837.

Sir—As vicar of the parish of St. Andrew the Great in this town, I am requested to inform you that it is the wish of the committee (appointed to carry into effect the re-building of the parish church) to adopt the method of a limited competition in the choice of an architect, and that the persons fixed upon are yourself, Mr. Rickman, Mr. Poynter, Mr. Sharpe (lately travelling Bachelor in the University), and Mr. Walter of Cambridge. We are anxious to accomplish something as worthy as possible of the example of former days, more especially as our church will stand in the middle of Cambridge, opposite to Christ's College. The sum we have raised is £3,300, we hope to realize £4,000 at least. I will candidly tell you that your new church at Stamford has pleased many here, though the inside has been thought not equal to the outside. Would you give us your opinion as to the probable expence of the like church at Cambridge—the freightage of stone I have heard put at £500 or £600. It is possible that something might be saved in our case by retaining and refacing the first story of the present tower, and the arches inside the church. But I shall be glad to supply you with any further particulars when assured of your readiness to send in a plan. I fear we cannot begin this year.

Your's, &c.,
(Signed) "Geo. Langshaw."

IMPROVEMENTS ON ECCENTRIC RODS.

Sir—I happened not to have seen any of your excellent numbers for this year till a few days ago; I see that there are several communications from Mr. Pearce, respecting an improved method of reversing engines with one fixed eccentric, which he has invented. I do not doubt that Mr. Pearce has the merit of making the discovery, but I merely write to state that about 18 months ago, when engaged in a large engineering establishment near Manchester, I made the same discovery, and made a model in wood which acted so as to give the lead with perfect accuracy both ways, and on the same principle, viz., by establishing a *proper proportion* between the length of the eccentric rod and the length of the double arms of the valve rocking-shaft. I am aware that engines have been reversed time out of mind, by means of a double lever on the rocking-shaft for working the valve, particularly coal-pit engines, and at one time Messrs. Sharp and Roberts of Manchester made the reversing gear of their locomotives on a similar plan, but so far as I know, no one has hitherto given the lead correctly both ways, by making the eccentric traverse a certain determinate angle in being shifted from one end of the lever to the other, and it is this which constitutes the merit of Mr. Pearce's invention.

I am, Sir,
Portland Street, Glasgow, Your obedient servant,
30th April, 1841. D. T.

PAPER ON HARBOURS AND RIVERS.

On the means of improving the Navigation of the River Lune up to the Port of Lancaster.

By John Rooke, Esq.*

The nautical survey of the river Lune up to the port of Lancaster, by Messrs. Stevenson, is illustrated by facts such as pure science requires in the framing of correct plans. Their report, however, is so brief, that scientific exactness could scarcely be expected, and indeed was not needed. Deepening the channel, on certain lines delineated on the plan of their survey, by the application of the dredging machine, until a specified depth and width of water is obtained, appears to be the main feature of their report.

But with some of their statements (and these concern the objects for which the report is drawn up most intimately) I am at issue; and in support of the objections here taken, all the exactness of details embodied in the survey and plan would seem to be called for. It is fortunate, therefore, that their proceedings have embraced so much exactness of information in detail. From Glasson to Heaton the diminution of fall in the channel of the Lune is about two feet and three-tenths per mile; and from Heaton to Lancaster, one foot and seven-tenths per mile. Messrs. Stevenson state in their report that "the

* This paper originally appeared in the Lancaster Guardian.

great object to be kept in view in carrying into effect the improvement of the navigation of the Lune, is the free admission of the greatest possible quantity of water from the sea." Conformably to this decisive conclusion, "The reporters beg leave particularly to point out the necessity of using much caution in encroaching on the tide-covered banks of the river, and the shutting out large portions of the tide water, and impeding the effect of that powerful, constant, and therefore most efficient of all agents in preserving the depth of navigable channels."

Directly opposed to this imperative conclusion, I should think that reliance ought to be chiefly placed upon the scour which the fresh water and tidal wave combined occasion in a fixed and compressed channel, because their united action and force is concentrated and constant: whereas, in a widely spread estuary, their action is trivial on any given line of channel, liable to change and to obstruct navigation. Hence a perfectly even, a compressed, and a securely fixed channel is that by which the navigation of the Lune may be the most effectually improved; and not by placing reliance on the scour effected by the tide chiefly, as Messrs. Stevenson would appear to intimate.

Agreeably to my view of the effect produced by the combined scour of tidal and fresh water in a compressed channel, is not silt frequently deposited along the quay of Lancaster by the tides in summer, which autumnal and winter floods of fresh water scour off again? This is so far an undeniable fact, and utterly at variance with the absolute theory put forth by Messrs. Stevenson. Let the fresh water stream be altogether withdrawn from the channel of the Lune, and in a very few years that channel might be confidently expected to become superior marsh land. Because the tidal force at its greatest power, according to the elaborate survey of Messrs. Stevenson themselves, during the flux of spring tides in the Lune, exceeds that of the reflux tides more than two fold; and hence more silt is driven upwards by such tides ("the most efficient of all agents in preserving the depth of navigable channels," as Messrs. Stevenson assert,) than the power of their reflux is adequate to carry back to the sea again. In so far all the facts collected by these engineers themselves, are utterly at variance with a theory on tidal agency, they have expressed in the most unqualified terms.

When they reported in such a manner on the navigable channel of the Lune, did they forgot that of the Clyde for fifteen miles below Glasgow? or have they witnessed the channel of the Tyne from Newcastle to Tynemouth? or that of the Avon from Bristol to King's Road? And are they unacquainted with the fact that the channel of the Thames, fixed in a compressed course by the strong ground of Tilbury on the north and Gravesend on the south, is navigable for steam boats, at all times of the tide, for seventy miles from the sea? These undeniable instances of compressed channels of navigation, may well be left to stand in evidence of themselves. Nor can I believe that a navigable funnel so perfectly true throughout, and splendid in outline as the Thames is, can have been otherwise formed than by the unerring science of a day gone by.

What have we on the opposite side of the account? The wide-spread estuary of Morecambe Bay, where there is water enough from the sea, combined with fresh water streams of great power. Then the Duddon claims our notice; and the Ribble also;—not to mention the Lune itself. The wash of Lincolnshire is another instance; and so is the Solway Firth. Now all these navigations are confessedly bad; and unimproveable except by compression. Then they might some of them rival the navigation of the Thames, the Tyne, the Avon, or the Clyde. In Kirkbride Loch, the channel of the Wampool, in five miles from the Solway Firth, loses about 15 feet of fall: it then assumes an exceedingly compressed form, and though but a trivial stream, it then maintains a dead level for three miles inland, along which high spring tides flow. Such a mass of strong evidence needs no comment.

Indeed, with a body of evidence before us so conclusive, why does the channel of the Lune undergo a diminution in depth of water from Heaton to Lancaster at all? The facts collected by Messrs. Stevenson answer this question satisfactorily. For a short distance below the quay of Lancaster the bed of the channel is found to be composed of three feet of hard gravel, resting upon fluviatile clay, or more properly speaking—compressed silt deposited by the flux tides of the sea. It is obvious that the crust of gravel which now forms the bed of the channel, has been brought down the course of the Lune by a succession of floods from the uplands, and deposited on those levels, which the combined reflux of tides and fresh water floods have not had power enough to scour out to sea. Yet on even these unequal terms, the loss of fall from Lancaster to Heaten is about 26 per cent. less per mile than from Heaton to Glasson. Had the tidal scour, therefore, on that portion of the channel where the admission of water from the sea is the greatest, and notwithstanding an accumulation of gravel from the Uplands, been equal to what it is where the tideway is the most compressed, the actual depth of water at Lancaster quay must have been three feet more than it is at present. With a body of facts and incidents so plainly in the possession of Messrs. Stevenson, for what reasons, or on what authority they adopted the theory of—"The free admission of the greatest possible quantity of water from the sea," I shall leave to their candid explanation; and I think myself abundantly justified in tearing away the entire foundation of a theory so fallacious and opposed to the improvement of navigable channels in general.

When all the evidences under which the port of Lancaster may be placed are brought into a distinct sum, the whole matter for consideration is plainly brought before the commissioners of the port, and awaits their decision. Shall the accumulation of gravel from the Uplands be allowed to continue until Lancaster ceases to be a port? Certainly not. The value of the quay and warehouses alone, not to say the prosperity of the town, and the traffic of its railway, demand the most spirited and well considered exertion, though the task left for their execution may be an arduous one.

Foremost in importance is the removal of gravel and silt from the channel of the Lune between the old bridge and Oxcliffe. Under skilful modes of carrying on the work, I should think that it might be accomplished for 6*d*. per cubic yard, as most of it could be stowed away at an easy distance. Dredging, including every expense, as estimated by Messrs. Stevenson, and taking into account penetrating an extended bed of hard gravel, may be fairly taken at 1*s*. 3*d*. per cubic yard. This so far decides in favour of the barrow, the pickaxe, and spade. Suppose then a removal of 240,000 cubic yards, at 6*d*. per yard, this head of expenditure would be 6,000*l*. In addition to this, a portion of dredging would be called for on ground where the working of the machinery was less hazardous and severe than upon hard beds of gravel. Admitting, therefore, that 80,000 cubic yards could be removed by contract at 1*s*. per cubic yard, the charge thereon would be 4,000*l*.; thus giving a total charge of 10,000*l*. In addition to these operations, were every facility given for the reclamation of land by silting it over within the channel of the Lune, 4,000 acres so reclaimed, at a deposition of 10,000 cubic yards per acre, would absorb 40,000,000 cubic yards on the whole, fix a secure channel, and give a depth of water at Lancaster quay surpassing the highest expectations, thus giving an impulse to the commercial activity of the town, and the prosperity of its manufactures.

Akehead, Wigton, Cumberland,
February 6, 1839.

Sir—Yesterday a gentleman placed in my hands Mr. Brooks' work on Rivers, Harbours, &c., and directed my particular attention to his "New Theory of the existence of Bars," among quotations of opinion on this most important subject, there appears one from a letter of mine which appeared some time back in the "Nautical Magazine," and which Mr. Brooks states are "the words of one who has devoted much time to the promulgation of his theory," *e. g.* "that egress sluicing, or scouring water is the sole cause of a bar;" that he is quite correct in this remark, your own columns bear testimony, and the records of parliament will also convey to posterity the fact that I first published to the world this novel thesis, and the equally novel principle of forming Harbours of Refuge with double entrances, without the use of back-water, a principle which is now recommended by the Commissioners in their Report of a Survey of the Harbours on the South East Coast, and for the same object, and in the same words, that I have used in reference to this affair, viz. "to afford to vessels a free ingress and egress, under all circumstances of the wind and weather."

Taking a deep interest in a matter of so much importance to this great naval and nautical nation, and numbering as I do among converts to my *thesis*, some of the most eminent scientific and practical men of the day, I beg you will be pleased to reserve for me in your next number, a space for the insertion of some observations on Mr. Brooks' Theory of Bars, as developed in the pamphlet referred to, in which observations I shall repeat my oft assertion "that bars are the effects of general, and not of partial laws, and that the bar at the entrance of Bow-creek, in the river Thames, results from the same cause as do the bars at the disemboguing of rivers in the Torres Straits, and on every other coast in the world." I state this from observations of more than 20 years made on harbours and bars in various parts of Europe, and in Africa.

I remain, your's, &c.

Henry Barrett.

London, May 25, 1841.

REVIEWS.

Treatise on the Improvement of the Navigation of Rivers, with a New Theory of the Cause of the Existence of Bars. By WILLIAM ALEXANDER BROOKS, M. Inst. C.E. London: Weale, 1841.

This work is the result of much reading and much research, deriving its materials not only from the engineering literature of England, but also from the best and latest continental writers. Although the volume is small, the labour and attention which have been bestowed are considerable, and none can peruse it without recognizing the spirit of inquiry which animates the writer. One only remark we have to make, which is, that our author does not seem to have done full justice to the contributers to this Journal, and other English writers, in omitting to mention the names of many of the parties, to whose theories he alludes.

In his introductory chapter Mr. Brooks defines several of the theories, proposed for explaining the formation of bars. First, Major Rennel's, which is that they are caused by the current losing its strength at a certain distance in the sea, and so depositing the substances carried with it.—2. Mr. Delabeche attributes it to the ocean piling up detritus on the shore —3. Mr. Rooke attributes bars to the strength of the current of the flood tide not running in the same channel with that of the ebb; or to the embouchure of the river not being freely open to the course of the tidal current.—4. Mr. Barrett's theory, as our readers know, is, that they are caused by the conflicting action of effluent currents passing into the ocean at right angles to the shore.—5. Another, and the most favourite theory is an imagined insufficiency of backwater.—6. An opinion entertained abroad is that bars arise from the streams in their approach to the sea spreading in surface and diminishing in depth, so as to deposit the sands.—7. Colonel Emy, an eminent French engineer quoted by our author, attributes these obstacles to the ground waves, or *flots de fond*.—8. We now come to the theory put forward by Mr. Brooks, which we shall let him give in his own words.

An accurate examination of the state of a bar river will exhibit a great irregularity of its surface at low water; in lieu of the river presenting at that period a longitudinal section of a succession of inclined planes, described in the preceding description of rivers free from bars, as becoming more and more gentle in proportion to their proximity to the ocean, it will be often found that the declination or slope of some of the upper reaches is less than those nearer the ocean; and the fall at low water in the lower reaches of the river is always so great, as to produce a striking difference in the vertical rise of tide, even at a short distance from the sea; and attendant upon this defective state of the section presented by the surface of the river at low water, is a great extension of the duration of the ebb, beyond that of the upward current of the flood tide.

The river being in this irregular state, the process by which the bar is formed may be thus described.

During the period of the first quarter flood, the current, in lieu of being able to take its natural upward course, as in rivers where no bar exists, is opposed, or effectually checked, by the effluent backwater; the declination of the stream in the lower division of the river presenting a head which insures a strong downward current, long after the tide would have been able to maintain an upward course, provided the backwater had had a free discharge. At this period the flood tide, by reason of its greater specific gravity, occupies the lower stratum of the tide-way, and like a wedge endeavours to force its course up the channel, which it is unable to effect, but merely elevates the lighter effluent water, the lower strata of which, being checked by the opposition of the tidal water, yields to the latter the sand or other materials, which it was capable of holding in suspension, previously to its encountering the conflicting action of the flood-tide; and where this takes place the bar is formed.

To the theory of Major Rennel (No. 1,) Mr. Brooks objects that it is insufficient because the operations described as producing bars take place in all rivers, even in such as having their waters most abundantly laden with sand or mud, are yet free from bars. On Mr. Delabeche's (No. 2), Mr. Brooks says that the action of the waves cannot be the cause, as bars are found in the most sheltered situations, while other rivers abounding with silt are nevertheless free from deposits in the most furious seas. To Mr. Rooke and Mr. Barrett (Nos. 3 and 4), the objection of our author is that in rivers subject to great variation at their entrance, the bar is always found to exist independently of the direction of the discharge into the sea. The backwater theory (No. 5), is confessedly insufficient, the mightiest rivers of the globe presenting staggering exceptions. To the 6th, it is opposed that in the Mediterranean no current is ever opposed to any stream, and that consequently the repose supposed to take place at the meeting of the currents cannot exist. Further, that in the ocean one of the two currents overcomes the other. Mr. Brooks objects to the ground waves or *flots de fond* acting on sudden elevations of the bed of the sea in the manner assumed by Colonel Emy, opposing to it the received opinion that breakers are formed immediately on any portion of the wave meeting violently the vertical face of the obstruction. In support of this view an appeal is made to the geological formation of the north coast of Yorkshire, where nothing is found to corroborate the Colonel's hypothesis. The case of the Adour quoted by Colonel Emy is well shown by Mr. Brooks to be an influence of local causes.

With regard to rivers being free from bars, Mr. Brooks supports Mr. Rooke's views, giving a good definition that whenever a navigable river approaches to the form of a simple inlet for the reception of the tide so far as regards the longitudinal section, presented by its surface at low water, it will either have no bar, or be but lightly obstructed by one. The same, he observes, may be said of those seaports or pier harbours, which though free from bars in their natural state, are well known to become encumbered by them immediately on the introduction of an artificial scouring power. The views of the previous writers, Mr. Brooks has carried out still further, and we are prepared to concur in much that he says. He remarks that

Resuming the investigation into the state of a river, whose entrance is free from a bar, we shall find that, from its junction with the ocean, a long line of navigable course exists with an extremely gentle fall, or slope of its surface, at low water; the river is in this case in a proper train, its longitudinal section presenting a succession of inclined planes, becoming more and more gentle, as they approach the ocean; and the lower course of the river, from the slightness of its fall, approximates to the condition of a frith, or deep inlet, of the coast, or to that of one of those large natural or artificial harbours, which, being mere tidal receptacles, wherein the influx and efflux take place in equal times, are necessarily free from bars.

The river being in this perfect state, as regards the slope of its surface at low water, a consequent attendant upon the latter will be an equal duration, or nearly so, of the period taken up by the flow of the flood tide, with that of the ebb, in the lower reach of the river; by the term flow being understood, the direct upward course of the current of the flood tide, immediately after the true time of low water.

Our author having propounded his theory, goes on to propose his remedies for the cases in which bars exist. His first remedy is to make the bed of the river of more regular inclination.

By this natural elongation of the course of rivers by the deposit of alluvial matter, a gradual amelioration of the navigation must take place, inasmuch as that elongation is necessarily attended with a more gradual junction with the waters of the sea, or the diminution of the velocity of the current at the point of discharge; we have therefore only to assist the operations of nature by directing the course of the current, and thereby the position of the deposit of the alluvions, to insure that the latter shall act beneficially and not prejudicially to the navigation.

He then goes on to provide for other cases.

In a tidal river, where a bar exists, and the reduction of the declination of the low water surface cannot be effected, by reason of a long length of rocky bed, too costly to remove, the only means available for its improvement is an artificial elongation of its course, by piers or other works, to bring the mouth of the river within the influence of a stronger current.

Where the declination of a river is great in its lower reaches, the result of any cut near the embouchure of the river, which is not attended by a simultaneous reduction of that declination, must be the increase of the bar. It is however to be observed, that the natural attendant effect of the shortening the course of the current, is the more free discharge of the water and abasement of the level of the surface of the current; and wherever this latter circumstance does not take place, it is solely due to the presence of some geological feature, such as rock or marl, which the current, when unassisted by art, is unable to act upon.

Upon the use of artificial scouring power, where used with the view of increasing the effect produced by the natural backwater of rivers, we find it observed.

Assuming, therefore, that the volume of the natural backwater is so small as to be inadequate to maintain a sufficient depth in the harbour for the maritime wants of the port, and that the aid of an artificial scouring power be requisite, still the latter should not be made use of, except during that period of the ebb when its effect is to remove seaward the matter held in suspension by the effluent water.

If, therefore, any portion of the artificial backwater be discharged during still water, or during any period of the flood tide, we may anticipate a rapid deposit, or accumulation on the bar.

In order to secure the utmost useful effect from an artificial scouring power, it is essential that its action be prolonged to a position which is within the range of a strong tidal current, or within the reach of the effect of the prevailing onward impulse by the surf, during on-shore gales.

Where the scouring power terminates *negatively*, if I may use the expression advanced by Major Rennel, or where the effect of the scouring power is unable to extend into a true tidal shore current, it is unreasonable to expect its utmost useful available result.

Thus, supposing the bar produced by a scouring power be situated in a sheltered situation in a bay, there can remain no hope for its improvement until the place of deposit be removed into the true run of the ebb tide.

With regard to the theory of Mr. Brooks, in our opinion it is as far as that of any of his rivals from being of universal application: in fact we doubt very much whether any such theory will ever be found as one which shall provide for all cases. We must, however, say unhesitatingly, that Mr. Brooks has by developing this theory made an important contribution, not merely to the progress of the investigation, but to the resources of engineering, for this theory will admit of a more general application than any other. We do not like Mr. Brooks condemning all the other theories propounded, for we certainly are of opinion that both the theory and the practice are highly in favour of some of them, as regards their application to such cases as come within their sphere.

The chapter on the causes of the existence of shoals in the beds of rivers, is a highly amusing chapter of controversy on most of the cases which now disturb the engineering world, such as the Clyde, the Wear, the Thames, the Tyne, the Lune, the Dee and the Mersey; the mere mention of which subjects, by the bye, is sufficient to show how much the attention of the profession, and the interests of the public, are engaged in investigations of this nature. The chapter on the causes of the bore, egre, rollers, pororoca, bar or mascaret, is a good contribution to an important investigation; we must, however, call our author's attention to the Solway, and several other English cases which he has not mentioned. Having thus called the attention of our readers to many points, to which we cannot refer at greater length, we must also inform them, that they must not infer from our notice that Mr. Brooks' work is one of theory only, for they will find it of great value on numerous practical points of harbour engineering.

We do not treat Mr. Brooks' work as a complete treatise on the improvement of rivers, and if we did so we should perhaps do him injustice, as he seems principally to have had in view the statement of his own theories, but we cannot leave it without pointing it to our readers as one of the best works on the subject, which has yet been written, and one which they will find calculated to give them much pleasure and much instruction.

On the Subject Matter of Letters Patent for Inventions. By Thomas Webster, Esq., of Lincoln's Inn, Barrister at Law. London: Crofts and Blenkarn, 1841.

There have been few subjects more debated than that of the operation of the Patent Laws, from which serious difficulties have been felt by all classes of inventors. This has caused a strong demand for Reform in the Patent Laws, an outcry in which we are little disposed to join, as we are more inclined to think that the evils have arisen from the mystifications and misconception of the law, than from any defect in the law itself. No one has exerted himself more than Mr. Webster has done to clear up this subject, particularly in his former work, "the Law and Practice of Letters Patent for Inventions," and he has continued his exertions to the same laudable end in the small volume now before us. Here he shows us what is the subject matter of Letters Patent, supporting the general doctrines by adducing a great number of cases decided. For the sake of simplification he classifies the proper subjects for a patent under three distinct heads.

I. An arrangement, combination, or composition of matter; the particular arrangement, combination, or composition being the essence and substance of the invention.

II. An arrangement, combination, or composition of matter, with the view of carrying out into practice certain truths, laws, or principles, the particular arrangement, combination, or composition, not being of the essence or substance of the invention, except as in connexion with and subsidiary to the truths, laws, or principles, which are to be so carried out into practice.

III. An application and adaptation of natural or known agents, and of known substances or things.

Mr. Webster next proceeds to describe what constitutes an invention.

The subject-matter of letters patent must possess the incident of novelty, or the principles of the common law and the words of the statute will not be complied with; and further, the result to which it leads must be a new manufacture. But every novelty is not an invention which may be the subject-matter of letters patent; the change must be such as may have resulted from the exercise of or given scope for thought, design, and skilful ingenuity. It is not necessary that either thought, design, skill, or ingenuity, should have been exercised—the invention or discovery may have resulted from guess or accident; and in a great number of cases the whole invention is but the conception of the idea; and whatever may have been the thought or labour before the idea was conceived, or the result attained in practice, yet inasmuch as the result itself gives no evidence of thought or labour, neither may have been exercised. This is peculiarly the case with many of the inventions which are applications of known agents and things, and described above under the third class. In most of these cases the practical application of the idea is easy and simple, and will suggest itself as soon as the idea; in fact, the whole invention is realized as soon as the idea is conceived. In these cases then it is only necessary that the possibility of thought, design, and skilful ingenuity, having been exercised, should not be excluded. The simple substitution of one material for another, as brass for copper, in any construction, may or may not be an invention or discovery which could be the subject-matter of letters patent. Suppose a machine for making iron nails in a particular manner—the application of that machine to making copper nails, there being no adaptation, no change in any part of the manufacture but the substituting of copper for iron, the machine being worked precisely as before, could not be the subject-matter of letters patent. Cases of this kind must be determined by other considerations, as the utility of the change.

This definition Mr. Webster supports by several cases in which the same doctrine has been laid down by the law authorities, and then proceeds in a similar manner to define what is novelty, non-use, and utility in a patent, concluding with a review of practical proceedings.

The various matters treated of in the preceding pages, may be illustrated and confirmed by a review of the practice of obtaining letters patent. The party soliciting the letters patent represents to the crown that he is in possession of an invention, which, as he believes, is new, and will be of great public utility. Thus the conditions of novelty and of utility are at once introduced as material and essential; the failure of either of them would be a ground for avoiding the letters patent, as having been obtained on false suggestion. Upon this representation, and on the consideration that it is entirely at the party's own hazard, whether the invention is new, or will have the desired success, and that it is reasonable for the crown to encourage all arts and inventions which may be for the public good, the law officer of the crown recommends the grant, with a proviso requiring the inventor within a certain time to cause a particular description of the nature of his invention, and in what manner it is to be performed, to be enrolled in the court of Chancery. This proviso gives rise to the specification, upon which instrument so much depends, for if it does not satisfy the terms of this proviso, and, further, is not a full and fair disclosure of all the inventor knows, the letters patent will be void.

We are very glad to find that Mr. Webster's well known scientific attainments have induced him, to turn his attention to the study of so important a branch as that of the Law of Patent Invention, and we have no doubt that he will find himself amply repaid by the results for the labour and talent he has devoted to these researches, while to the patentee it will be a great advantage to find that they have a barrister, who is so well acquainted with every department of the subject, one who unites to the acumen of the barrister, a practical knowledge of mechanics and science.

The Mechanics of Engineering, intended for use in Universities and in Colleges of Engineers. By William Whewell, B.D., Professor of Moral Philosophy in the University of Cambridge. London: Parker, 1841.

If we wanted any proof of the high estimation in which engineering now stands as a profession, we shall find it in the present work, where a man of Professor Whewell's attainments feels himself called upon to contribute towards its elementary instruction. The motives which have urged him to this work are so laudable, and they are expressed in a manner so well calculated to give sound counsel to the profession, that we think we cannot do better than insert the following extract.

Various circumstances at the present time make it desirable that the subject of engineering should be treated in such a mode that it may be made a satisfactory part of a liberal education. I refer not only to the attempts now so laudably making in various quarters to improve the professional education of engineers, but also to the desire which is more and more felt in the country, that what our students learn of mathematics in their university career should have some meaning in real life. *In the science of mechanics it has especially happened that the mathematical study of the subject has been pursued with very little regard to its practical application. The consequence of this is, not only that our theoretical teaching is of little value in preparing a person for any part of the business of engineering, but also, that it is of little value as intellectual discipline.* For the student has not been taught to seek and to find, in the mechanism which he sees about him, the exemplification of his theoretical principles; and hence he never learns to think steadily upon the subject, and when his days of pupilage are past, ceases to think upon it at all. This could hardly happen if his education made him familiar with principles readily applicable to every machine and every structure which came in his way; for in that case he would be constantly stimulated to understand what he saw; and clear views of mechanical relations would become part of the habits of his mind. The relations of space once learnt in geometry do not fade away from our thoughts, because throughout our lives we continue familiar with exemplifications of them in geography, astronomy, and other common pursuits. If the common problems of engineering were to form part of our general teaching in mechanics, this science also might become a permanent possession of liberally educated minds. Every roof, frame, bridge, oblique arch, machine, steam-engine, locomotive carriage, might be looked upon as a case to which every well-educated man ought to be able to apply definite and certain principles in order to judge of its structure and working. And this would, I conceive, be an improvement, not only in professional, but in general education.

Motives, expressed in this modest manner, deprive us of any observations on a work in which Mr. Whewell has shown himself anxious to consult his own reputation and the wants of the public. There are too many who think that a mathematician or a calculator is an engineer, and are too ready to despise practical attainments in the pursuit of abstract studies, so that we feel much indebted to Mr. Whewell, himself a mathematician, for giving so necessary a caution to those who might be led away by the study of a book so delightful as his, into realms so remote from engineering. Mathematics and engineering are roads which for a certain distance are mutual, but we feel obliged to give a hint that there is a point of divergence when the wayfarer has the choice of two separate and far distant paths.

Plans for the Formation of Harbours of Refuge, Improvement of Rivers, and Suggestions for Ameliorating the Condition of Seamen, Preventing Shipwreck, and Miscellaneous Matter. Illustrated with Plates and Charts. By Capt. J. N. Taylor, R.N., C.B. Plymouth, 1840.

Capt. Taylor's plan for the formation of harbours of refuge is by the use of a floating breakwater, this he proposes to secure by moorings of logs of timber shackled together, so as to avoid the inconvenience of chain moorings. The work before us is more accurately described by the title prefixed to the first page, Series of Papers, &c., being a collection of memoranda on naval engineering, and naval officers generally. It includes descriptions of several of Captain Taylor's inventions.

Gas Lighting.

1. *A Practical Treatise on Gas Lighting, with Twenty-two Plates.* By Thomas S. Peckston, R.N., C.E. London: Hebert, 1841. (Third Edition).
2. *A Practical Treatise on the Manufacture and Distribution of Coal Gas, illustrated by Engravings from Working Drawings.* By Samuel Clegg, jun., C.E. London: John Weale, 1841.

We have no doubt that our readers who look at these works will do as we have done, pair them together. The names of Clegg and Peckston are extensively known as connected with the subject of gas lighting, so that works emanating from either of them must be hailed by the student and professional man as useful additions to the engineering library. "Arcades ambo" as they are it is difficult for us to decide upon their claims, so that we must earnestly recommend to our readers to purchase both works, and see if they can more readily bring the matter to an issue. Mr. Peckston has long written on gas lighting, and Clegg has been intimately connected with the improvement of the system almost from its very invention, having been one of the first to carry it out on a large scale—what he has done since all the world knows. The work of Mr. Peckston is in its third edition, a circumstance which renders it unnecessary for us to urge claims on which the public has already pronounced, and which will excuse us for any apparent neglect in devoting more of our attention upon this occasion to the first effort of the younger candidate. To say that the profession have looked forward to young Mr. Clegg's work with interest, is to say no more than the bare truth, for the list of subscribers shows the names of all the first gas engineers in the country, who thus have already expressed their confidence as to his competency for the task he has assumed. They could not well doubt this, for he comes to the subject armed not only with his own knowledge and experience, but with those of his father, to whose valuable memoranda he has had ready access.

The distribution of both works is much the same, the introductory chapters giving a short history of the progress of the art, a sketch of chemistry as applied to this manufacture, and an account of coal. From the statements of Mr. Peckston and Mr. Clegg, it appears that the late talented Mr. Murdoch was the first person who introduced gas lighting for practical purposes. He first lighted his own house at Redruth, in Cornwall, in 1792; afterwards in 1798 he erected an apparatus for a similar purpose at the manufactory of Messrs. Boulton and Watt, at Soho—a pleasing reflection to find that the great improvers of the steam engine should also be the first to patronize the introduction of lighting by gas against all the prejudices and superstitious feeling of the day—the next place lighted, by Mr. Murdoch, upon a large scale, was a cotton manufactory at Manchester in the year 1805, the apparatus for which was made at the works of Messrs. Boulton and Watt. A paper by Mr. Murdoch describing the apparatus was read before the Royal Society, February 25, 1805, from which paper we collect that the number of burners employed in the manufactory amounted to 271 argands and 633 cockspurs, each of the former giving a light equal to four candles, and the latter a light equal to 2¼. It appears, that at the same time Mr. Murdoch was engaged in fitting up the gas apparatus at the above manufactory, that Mr. Clegg (the father of the author), was engaged in a similar manner for lighting a cotton mill near Halifax, which Mr. Clegg states was lighted a fortnight before the cotton mill at Manchester, a circumstance however which does not militate against the claims of Mr. Murdoch as being the first who introduced gas lighting for practical purposes. The next place lighted was the Catholic College at Stonyhurst, Lancashire, (in 1807, 1808), when Mr. Clegg had an opportunity of making several experiments for purifying the gas, using for that purpose lime water in a separate vessel, which was to render the gas pure. We now come to the time when gas was attempted to be introduced upon a large scale for lighting the public streets, when we find ourselves indebted to Mr. Winsor for his indefatigable zeal, in exerting himself (even as early as 1803-4,) by lecturing and other means, to overcome the prejudices of the public; through his exertions a company was formed in 1809, called "The London and Westminster Chartered Gas Light and Coke Company," in that year application was made to Parliament for incorporating the company, but from the obstinacy and prejudices of several parties, as is too frequently the case in new undertakings, the Bill was opposed, and it was not until 1810 that an Act was obtained. During this time Pall Mall was lighted up, but so far from prejudices being allayed, the project was treated with derision by many of the scientific men of that day. Mr. Clegg next proceeds to detail the difficulties the Company had to overcome in the erection of their works, and introducing the gas for public purposes, and it was not until 31st December, 1813, that the Company were able to light any public place, when they lighted Westminster Bridge. Thus we see that a period of 21 years was lost from the date of the first introduction by Mr. Murdoch, before gas was generally adopted.

The early part of Mr. Clegg's volume is occupied with a dissertation on "Chemistry as applied to the Manufacture of Coal Gas," followed by a chapter on "Coal," which affords much valuable information.

The kinds, or rather the different names, of coal used at the London Gasworks are, South Pelaw, Ellison's Main, Felling Main, or East Garesfield Main, Dean's Primrose and Pearith's Wall's-end. Most of the Companies have the facilities of water-carriage, and purchase their coals at the pit for about 7*s*. 6*d*. per ton, and charter a vessel from 8*s*. to 11*s*. per ton, according to the time of the year. If the gas-works are far from the water-side, and they purchase their coals at the market, the above would fetch from 17*s*. 6*d*. to 18*s*. 6*d*. per ton; and to a large consumer, for cash, 5*s*. would be charged for cartage, making a total of 22*s*. 6*d*. to 23*s*. 6*d*. If the gas-works are at the water side, the charges would be as follows:—

	s.	*d.*
Cost of coal at the pit mouth, say	7	6
Freight and loading	8	0
Lighterage from ship to wharf	0	10
Gang of men carrying from barge to works, per ton, according to distance	1	0
Duty 1*s*. 1*d*., and weighing 1½*d*. . . .	1	2½
	18	6½

At Birmingham and in the neighbourhood the price for Staffordshire coal is about 8*s*. 6*d*. per ton, including all expences.

In Scotland the prices, per ton, paid for the different kinds of Parrot coal at the places where they are shipped, are as follows:—

	s.	*d.*		*s.*	*d.*
Lesmahajo . .	17	0	Marquis of Lothian	17	6
Monkland . .	16	0	Capledsea . .	14	0
Torry Burn .	12	0	Halbeath . .	12	0
Wemyss . .	13	6	Lochgelly . .	10	0

The price of coke in London varies according to the demand; to retailers who fetch the coke it is now about 16*s*. per chaldron, to private persons 18*s*., and if delivered, from 21*s*. according to the distance. At West Bromwich coke is considered on an average to be worth 4*d*. per bushel.

Under the head of "Advantages of Gas," Mr. Clegg has afforded us some sound practical observations and calculations, which cannot fail to be highly appreciated by the engineer: the following calculation of the cost, outlay and income of a small gas work is useful, as it shows at what a comparatively trifling expense villages might be lighted.

If the number of lamps required is known, the materials necessary for the production of the gas to supply those lamps are known also. The profit and loss of such establishments in actual operation may as surely be relied upon as that given upon paper.

Upon a well-regulated system the cost of producing every 1000 cubic feet of gas with the same coal will not vary one penny the whole year round; the quantity of gas made will be adequate to the demand, and no more. The wear and tear of the machinery will be exactly that which was anticipated, and therefore the annual outlay will be known; the sale of the products of the establishment may be depended upon with equal certainty, and the income known; the profit arising from the difference is thus ascertained. I will give as an example the results of a small gas establishment erected in the country.

	£	s.	d.
Apparatus for the supply of 70 public and 75 private lamps cost	500	0	0
Retort-house and chimney	130	0	0
400 yards of 4-inch pipe	101	13	4
740 do. 3-inch do.	129	0	0
266 do. do.	39	13	0
	£900	6	4

Outlay in	1838			1839.		
Coal carbonized	204	17	11	204	19	2
Do. as fuel	54	15	0	54	14	0
240 bushels of lime	6	0	0	6	0	0
One man by day and one by night	62	8	0	62	8	0
Carried forward	£328	0	11	£328	1	2
Brought forward	328	0	11	328	1	2
Lamplighter	31	0	0	31	0	0
Repairs in the streets	15	0	0	16	3	0
Repairs in the works, including wear and tear of retorts, meter and clock	60	0	0	58	16	0
Rent of ground	20	0	0	20	0	0
Taxes	20	0	0	20	0	0
Office expenses	10	0	0	10	0	0
	£484	0	11	£484	0	2

Income in 1838				1839.			
72 private lamps at 3*l.* =	216	0	0	75 at 3*l.* =	225	0	0
64 public do. at 4*l.* =	256	0	0	64 at 4*l.* =	256	0	0
200 gallons of tar at 1*d.* =	0	16	8				
Coke, 247 chaldrons, at 16*s.* =	197	12	0	243 at 16*s.* =	194	8	0
	£670	8	8		£675	8	0
Leaving a Profit of	£186	7	9		£191	7	10

The equal results of these two years is not peculiar to this establishment; there are many of much greater extent that can compare with it.

The chapter on "Retorts," describes the different plans that have been adopted, their faults and advantages, their mode of setting, construction and cost, and is illustrated with some beautiful engravings and wood cuts. The annexed engraving shows the construction of a retort, and the manner in which it is set, when a small quantity of gas is required.

In country towns, where the quantity of gas made during the winter seasons does not exceed 10,000 cubic feet in twenty-four hours, the retorts must be set singly, as represented in Figs. 1 & 2., the flue passing beneath and over the retort, which rests upon a half-brick arch, cut flat at the top to receive it; the end is guarded by a thick fire-tile.

Fig. 1.

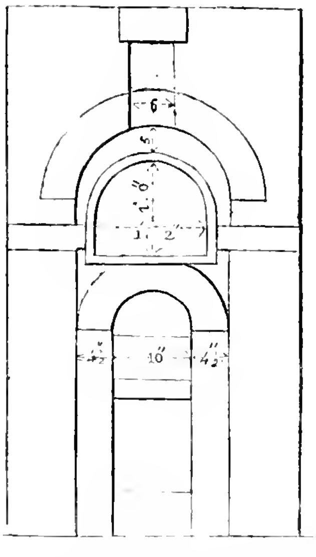
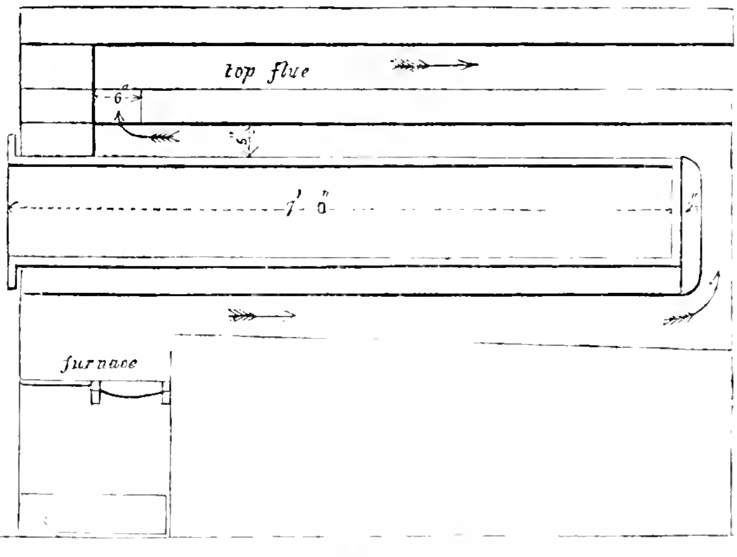


Fig. 2.



Mr. Croll, the superintendent of the Chartered Gas Company's works, (Brick Lane station), has introduced a system of using the coke as fuel while red-hot. The charge from the retorts is drawn into a wrought-iron carriage, and immediately taken to those furnaces which require feeding. He informs me, that the saving effected by this simple process is equal to 10 or 12 per cent.; I should conceive it to be fully that. The reason is evident; because when a quantity of black coke is thrown on the previously heated mass of fuel, the flues will to a certain extent become cool, since the heated air is absorbed. When hot coke is thrown on, no absorption takes place, and the flues are kept up at a uniform temperature.

Mr. Clegg speaks very highly of Mr. Grafton's fire clay retort.

In England and Scotland the fire-clay retort has superseded the use of metal in no less than forty towns; in some instances it has lasted for the extraordinary period of twelve years; while, during this time, at all other works where the invention is not yet used, it may be asserted that iron retorts have been renewed as many times. The oven or D-shaped retorts are found to be the most advantageous, being made with a capacity to carbonize one cwt. of coal every hour. They can be constructed either to be heated by coke ovens, or coke furnaces, or by the burning of tar: with coke ovens they are more durable. It appears that clay retorts, when constructed upon such a scale as that given in the plate, have great power to *retain* their heat when brought to the proper temperature for decomposing the coal, viz. 27° of Wedgewood.

This power of retaining heat is proved by constant practice to produce 1000 cubic feet of gas per ton from the same coal more than the average of the London produce, and the consumption of fuel is not more than 22 or 23 lb. of coke to carbonize 100 lb. of Newcastle coal, taking the average of six months' working; it is even less with the Staffordshire or Lancashire coal.

We have now shown by our extracts the value of this excellent work, and in the next number we shall proceed to notice the remaining part of Mr. Clegg's book; in the mean time we hope that both the volumes will be in the hands of all those who are desirous of obtaining information on the subject of gas works.

Before we close the present notice, we must offer a just tribute of praise to Mr. Gladwin the engraver, for the very clear manner in which he has executed the plates in Mr. Clegg's work, which are so beautifully delineated, that they cannot fail to convey, even to the non-professional observer, an accurate knowledge of the construction of the apparatus which they delineate.

XENOPHON ON THE ATHENIAN MINES.

Extracted from the Translation by Walter Moyle, Esq., of the Pamphlet on the Improvement of the Revenue of Athens.

Our silver mines alone, if rightly managed, besides all the other branches of our revenue, would be an inestimable treasure to the public. But for the benefit of those who are unskilled in inquiries of this nature, I design to premise some general considerations upon the true state and value of our silver mines, that the public, upon a right information, may proceed to the taking of such measures and counsel as may improve them to the best advantage.

No one ever pretended from tradition, or the earliest accounts of time, to determine when the mines were first begun to be wrought, which is a proof of their antiquity; and yet, ancient as they are, the heaps of rubbish which have been dug out of them and lie above ground, bear no proportion to the vast quantities which still remain below, nor does there appear any sensible decay or diminution in our mines; but as we dig on, we still discover fresh veins of silver ore in all parts, and when we had most labourers at work in the mines, we found that we had still business for more hands than were employed.

Nor do I find that the adventurers in the mines retrench the numbers of their workmen, but purchase as many new slaves as they can get; for their gains are greater or less, in proportion to the number of hands they employ. And this is the only profession I know of where the undertakers are never envied, be their stock or profits ever so extraordinary, because their gains never interfere with those of their fellow traders.

Every husbandman knows how many yoke of oxen and servants are necessary to cultivate his farm, and if he employs more than he has occasion for, reckons himself a loser; but no dealer in the silver mines ever thought he had hands enough to set to work.

For there is this difference between this and all other professions; that whereas in other callings, for instance, braziers and blacksmiths, when their trades are overstocked, they are undone, because the price of their commodities is lowered of course, by the multitude of sellers; and likewise a good year of corn, and a plentiful vintage, for the same reason do hurt to the farmers, and force them to quit their employment, and set up public houses, or turn merchants or bankers. But here the case is quite otherwise, for the more ore is found, and the more silver is wrought and made, the more adventurers come in, and the more hands are employed in our mines. A master of a family indeed, when he is well provided with furniture and household goods, buys no more, but no man was ever so overstocked with silver, as not to desire a farther increase; if there are any who have more than their occasions require, they hoard up the rest with as much pleasure as if they actually made use of it. And when a nation is in flourishing circumstances no one is at a loss how to employ his money; the men lay it out in fine armour, in horses, and in magnificent houses and buildings; women lay it out in great equipages, costly habits and rich clothes. And in accidents of war, when our lands lie fallow and uncultivated, or in a public dearth and scarcity, what reserve have we left to apply to but silver, to purchase necessaries for our subsistence, or hire auxiliaries for our defence? If it be objected that gold is as useful as silver, I will not dispute it; but of this I am sure that plenty of gold always lowered its value, and advanced the price of silver.

I have insisted the longer upon these general reflections to encourage adventurers of all kinds, to employ as many hands as possible in a trade so advantageous, from these plain considerations that the mines can never be exhausted, nor can silver ever lose its value.

That the public has known this long before is evident from our laws, which allow foreigners to work our mines upon the same terms* and conditions as our own citizens enjoy.

But to draw this discourse more immediately to the subject of my present consideration, which is the maintenance of our citizens, I will begin to propose those ways and means by which the silver mines may be improved to the highest benefit and advantage to the public. Nor do I set up for the vanity of being admired for an author of new discoveries; for that part of my following discourse, which relates to the examples of the present age, lies obvious to all the world; as for what is past it is matter of fact, and every man who would be at the pains of inquiring might inform himself.

It is very strange that after so many precedents of private citizens of Athens, who have made their fortunes by the mines, the public should never think of following their example; for we who have heard that Nicias, the son of Niceratus, had a thousand slaves employed in the mines, whom he let out to Sosias the Thracian, upon condition to receive an obolus a day, clear of all charges for every head, and that the same complement of workmen should be always kept on foot. In like manner Hipponicus had six hundred slaves let out at the same rate, which yielded him a revenue of a mina a day, and Philemonides three hundred, who brought him in half a mina a day, and many others made the same advantage, in proportion to the number of slaves they possessed. But what need have we to appeal to precedents of an older date, when at this day we have so many instances before our eyes of the same nature?

In the proposals which I offer, there is only one thing new, namely, that as private men have a constant revenue coming in from the slaves whom they let out to work in the mines; so the public, in imitation of their example, should purchase as many slaves to be employed in the same manner, as will treble the number of their own citizens.

(Xenophon then goes to argue on the advantages of this plan.)

To demonstrate that the mines would take up a greater proportion of slaves to work them, I appeal to the authority of all the living witnesses who remember, what numbers of workmen were employed in them before the taking of Decelea* by the Lacedemonians. And our silver mines that have been wrought for so many ages, with such numbers of hands, and continue still so far from being drained or exhausted, that we can discover no visible difference in their present state from the accounts our ancestors have delivered down to us, are undeniable proofs of my assertion. And their present condition is a good argument that there never can be more hands at work in the mines than there is employment for: for we dig on still without finding any bottom or end of our mines, or decay of our silver ore. And at this day we may open new mines as well as in former ages, and no one can determine whether the new mines may not prove richer than the old ones. If any one demands why our miners are not so forward in pursuit of new discoveries, as formerly; I answer, it is not long since that the mines have begun to be wrought afresh, and the present adventurers are not rich enough to run the risk of such an undertaking. For if they discover a rich mine, their fortunes are made; but if they fail, they lose all the charges they have been at; and this consideration chiefly has discouraged the adventurers from trying an experiment so dangerous.

(Xenophon here urges upon the state to take measures for discovering new mines.)

Companies of private adventurers may carry on the same trade in a jointstock, nor is there any danger that they and the national company will interfere with one another; but as confederates are strengthened by their mutual assistance to each other, so the more adventurers of all kinds are employed in the mines, so much larger will be the gains and advantages to all.

(Our author again dwells upon the advantages of his plan, and in allusion to the probable effects of a foreign war he says)

And I have reason to believe that it is possible to work our mines in the conjuncture of a foreign war, for they are covered on the south by a strong citadel in Anaphlystus, and on the north sea by another in Thoricus, and these two fortresses lie at the distance of but 60 furlongs from one another. But if a third fort were built upon the top of a mountain, in the middle of the two former, the three works would meet together, and other silver mines would be inclosed in a circle, and guarded on all sides, and the workmen at the first notice of an invasion might retire to a place of safety. But if we are invaded by more numerous armies, our enemies may make themselves masters of our corn, wine, and cattle that lie without the works, but if they possess themselves of our silver mines, what can they find to carry off more than a heap of stones and rubbish? But how is it possible for our enemies to make an inroad upon our mines? for the city of Megara, which lies nearest is above 500 furlongs from them; and Thebes which is nearer them than any but Megara, is more than 600 furlongs distant from them.

(We here again omit what Xenophon says about the advantages of his plan.)

The revenue arising from our slaves would not only make a considerable article in the charge of maintaining our citizens, but by the vast concourse of people from all parts, the customs of the fairs and markets at the mines, and the rent of our public buildings and melting houses, and many other heads, would produce a mighty income to the state. The state, upon such an establishment, would be peopled with a prodigious number of inhabitants, and the value of lands at the mines would be as high as those that lie near Athens.

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* This was a tribute of a twenty-fourth part of the silver found, according to Suidas.

* When 20,000 Athenian slaves deserted.

ON BURNING GAS FOR HEAT OR ILLUMINATION.

By Sir John Robison, K.H., Sec. R.S.E., M.S.A.

The two following papers were read, March 1839, before the Society of Arts for Scotland.

On the best means of Burning Gas for supplying Heat.

"*Vix ea nostra voco.*"

When carburetted hydrogen gas is employed in producing heat, it is seldom required that it should, at the same time, give out light; the combustion may, therefore, be managed in any way which may be convenient without seeking to preserve the illuminating power. It appears to have occurred about the same period to the late Dr. Duncan and to myself, that, by passing a current of gas, mixed with atmospheric air, through a wide vertical tube, having its upper end covered by a diaphragm of wire gauze, and by kindling the mixture as it escaped through the interstices of the wire cloth, a convenient stove might be formed for culinary purposes. Dr. Duncan applied some small apparatus on this principle to pharmaceutical operations in his class-room, and I had my kitchen furnished with a range of large stoves, which were intended to supersede the use of French charcoal stoves in various culinary processes. In both cases the success has been perfect, and the same principle has since been adopted with advantage in a variety of processes in the useful arts, where this neat and cleanly method of applying heat has rendered it a valuable acquisition to the work-shop.

The form of the apparatus may be varied in any way to suit the particular process to which it is to be applied; as all that is essential is, that a current of the mixed gas and air shall rise through wire-cloth, and that the proportion of gas to atmospheric air shall never be so great as to allow of the flame becoming yellow, as, with this precaution, the combustion of the carburetted hydrogen will be complete, and no deposit of soot will take place on cold bodies when set over the flames; the proper quantity of gas in the mixture is easily determined by the stop-cock belonging to each stove.

For ordinary culinary purposes, the cylinders may be thirty inches long, and three to four inches diameter, and the wire-cloth for the tops should have about thirty wires to the inch. That which is manufactured for safety-lamps answers well for this purpose.

Whenever, from accidental injury or decay, a hole takes place in a diaphragm, it is no longer possible to use it: as, when lighted, the flame passes through the fracture, and communicates with the jet at the bottom of the cylinder, which then burns like an ordinary gas-light, and, like it, would blacken the surface of any cold body presented to it. The wire-cloths, if not broken through by violence, will last for months although in daily use; and, if covered by a layer of coarse sand or pounded limestone, will continue serviceable for an unlimited period.

When more intense heat is required than is attainable by the unaided combustion of the mixed gases, recourse may be had to various forms of blow-pipes: and when a large volume of such flame is to be employed, the current of atmospheric air may be urged by double bellows. A very efficient apparatus on this principle is to be seen in the laboratory of Dr. D. B. Reid.

It is to be regretted, that such applications of gas are not more generally known and introduced into work-shops, as there are numerous processes in the arts in which they would afford facilities to the workman which he can scarcely command by any other means. For example, in the hardening of steel tools, it is well known that a piece of bright steel, when heated to redness in a forge or muffle, is subject to oxidation, and that a black scale remains after hardening, which it is difficult to remove without some injury to the work, as in the case of a screw tap; whereas, if the same piece of steel be heated in a flame of the mixed gases, where there is no free oxygen to attack its surface, it may be *made and kept* red hot without any injury to its finest edge; it will be discoloured, but without losing much of its polish. The artist has also the advantage of a distinct view of the article while it is being heated, and the power of withdrawing it from the flame the moment it has acquired the proper colour, which, in the hardening of cast steel cutting tools, is of great importance.

Many attempts have been made to apply carburetted hydrogen and pure hydrogen gases to the purposes of warming buildings, and various forms of stoves have been proposed, on the understanding, it would appear, that, by applying the flame of the gas to metallic bodies, an increased degree of heat would be communicated by them to the atmosphere around. A little consideration will show, that however the *distribution* of heat may be modified by such contrivances, there can be no increase of the heating power; and that when a certain measure of gas is fairly burned, the heat evolved into the apartment will be the same whether the flame be disposed as a light, or made to play against metallic plates or other combinations of apparatus. In all cases where the products of the combustion are allowed to mix with the atmosphere of the apartment, without provision being made for carrying them off by ventilation, the effects of such processes must be more or less deleterious to health, according to the proportion these products bear to the mass of air they mix in. On the whole, it may be assumed, that this mode of heating apartments is the most expensive, the least efficient, and, excepting that by Joyce's charcoal stove, the most insalubrious that can be resorted to.

On the best method of Burning Gas for the purpose of Illumination.

The theoretical principles on which carburetted hydrogen gas may be used with the best advantage, for the purpose of domestic illumination, have been so well laid down by the late Dr. Turner, and by Dr. Christison, as well as by other chemists, that it would be superfluous to enter at all on this part of the subject in a paper, the object of which is to give such practical directions for the proper construction and management of gas-fittings, as may lead workmen to give the requisite forms and proportions to the parts, and may enable the consumers to obtain the quantity of light they require, from the smallest practicable expenditure of gas, and with the least possible inconvenience from the products of its combustion.

It is very generally believed, by workmen and others, that the more freely the current of air is admitted to an argand burner, the better will be the light; and hence the burners and glass chimneys in ordinary use are made in such a way as to favour this view. No practice, however, can be more incorrect, or can lead to less economical results. An attentive observation of what takes place will show, *that there is only a certain proportion of air required for the favourable combustion of a definite measure of gas.* If more air than this due proportion be allowed to pass up the chimney, the size of the flame will be reduced, and the quantity of light diminished; if, on the other hand, less than the due proportion be admitted, the surface of the flame will be increased by elongation, but it will become obscure, and the quantity of light will decrease, owing to the escape of particles of unconsumed carbon. A simple experiment will exemplify this. If the flame of an ordinary argand burner be reduced, by partially shutting the cock, to about half an inch high, the light will be pale and blue, because the supply of air is too great for the small quantity of gas which is issuing. If partial obstruction be given to the access of air, by applying a handkerchief under the burner and chimney, it will be found that the size of the flame and the quantity of light emitted will increase until it arrive at a maximum, when, by farther obstruction, the admission of air will be reduced below the proportion required for the burning of the carbon, and the light will diminish.

It appears, therefore, that the proportionate size and shape of the burners, and the diameter and height of the glass chimneys, are by no means indifferent matters, but that much advantage may be gained or lost by giving them such forms and proportions *as may insure the development of the maximum degree of light which the gas is capable of affording.*

As a general rule, it may be considered that in all burners, whether well or ill made, the greatest quantity of light, *in proportion to the gas expended*, will always be obtained when the flame has been raised as high as it will go without smoking. In proof of this, the following experiment may be made. In any situation where there are three or four burners of the same size, and with similar chimney-glasses, and receiving their gas through a meter (by which the expenditure may be measured), if one of these burners have its flame elevated as high as it can be made to burn without smoking, and if its expenditure per hour be accurately noted on the meter, if the other two or three burners be then lighted, and their flames be so regulated that their united lighting power shall be just equal to the large flame of the first burner, it will then be found, on noting the expenditure, that it is much greater than in the case of the equal light from the single burner, and that the first burner, which gives light equal to two others, consumes but two-thirds of the gas which they do, or, if it be compared with three others giving together an equal degree of light, its consumption will be little more than half of theirs. It follows from this, that when a certain degree of light is required, such a burner should be employed as *is capable of giving this light and no more*, and that it is bad economy to use a more powerful burner with a flame of less than its due height. This rule holds good with any number of burners, and is equally true whether they be well or ill made.

The same rule will apply to the individual jets of an argand burner, as holds in regard to their united effect, and if, in any burner, the jets be of unequal heights, in consequence of bad drilling of the apertures, or neglect of keeping them free of dirt, the consequence will be, that when the flame is raised until the jet from the widest hole reaches the most advantageous height, those from the obstructed holes will be consuming the gas at a disadvantage, which will be greater or less according to circumstances, but will always be of greater amount than is generally supposed.

The experiments made by Drs. Turner and Christison serve to show, that much smaller chimneys than those usually employed are required to burn the gas to the best advantage. Unfortunately, however, the dimensions most favourable to economy in one respect, are beyond the limits of economy in another; and when the glasses are made small enough in diameter to obtain the maximum of illuminating effect, they are liable to be softened by the heat: or to be cracked, *if not accurately centred.* A compromise between the two evils must therefore be made, and if this be judiciously done, *a great improvement on the usual routine practice may be effected, a more beautiful and steady light be obtained at a less cost, and our domestic comfort be increased, by the diminution of the heat and effluvia of the gas.*

For practical purposes, therefore, the following directions may be observed.

Whatever diameter is given to the burner, the glass chimney should not exceed it by more than half an inch at the utmost. If the burner be less than three fourths of an inch in diameter, the chimney glass should not exceed 1⅛ inch in internal diameter. In any case, its height should be no more than four inches above the mouth of the burner from which the jets spring.

The smallness of the interval which is in this way allowed between the flame and the glass, renders it necessary that the workmanship of the supporting gallery be accurate, *in order that the chimney may be held perpendicular, and truly concentric with the flame.* Gas-fitters rarely give sufficient attention to this important point, and a large share of the expense from broken glasses is owing to defects in this particular.

In the ordinary mountings, the gallery is put on the burner, which it seldom fits accurately, the glass likewise rarely fits tight into the socket of the gallery, and from these two causes, it is often so much off the centre, or so far from being upright, that the flame cannot be raised to a proper height without risk of breaking it. This risk may be greatly diminished by a little change in the disposition of the burner and gallery. Instead of hanging the gallery on the burner, it should be placed beneath it, and fixed by screwing down the burner on it. In this case, it is necessary to give the gallery an increased diameter, as the air, both for the inside and the outside of the flame, must enter through its ribs. The burners should also be made conical instead of cylindrical; but this is not so important as drilling them with numerous holes—at least double the number usually allowed, as the closer they are the better, the expenditure being regulated by the stopcock, and not by the number of holes.

In making the galleries, great attention should be paid to having the rim and seat for the glass truly concentric with the hole through which the nozzle-screw, on which the burner is fixed, passes; the workmen should have a solid wooden chuck of the size of the bells of the chimney-glasses, and should chuck the galleries on it, in order to drill the aperture through which the nozzle-screw is to pass. The outside and inside faces of this hole should at the same time be turned true, as, if this be done with the proper care, the glass, the burner, and the gallery, will all be true to the same axis, when they are put together and screwed up. The hole through the gallery should not be tapped, as the burner is sufficient fixture for it when screwed down over it. If this part of the work be well executed, even an indifferently made burner will perform well, and if it be ill done, the best burner will appear defective, and be liable to break the glasses.

The arrangement of burner and gallery here recommended is not incompatible with the use of plain cylindric glasses, but it will be found better to use what is sometimes called the French-shaped chimneys, that is, those which are used with the common argand oil-lamps. The wideness of their mouths gives them a firm seat in the gallery, and if the length of the bell, or wide portion of the glass, be such that the neck or choke shall be on the level of the lip of the burner, and the upper part of the glass be four inches to four inches and a half long, then a favourable result will be obtained. It is expedient to obscure the lower part or bell of the glass, as the burner is thereby concealed, and the flame appears to rise out of a thick wax-candle. No moon-shades should ever be used, as, besides intercepting a considerable portion of the light, they prevent the consumers from observing whether the burners and glasses be in good order, and performing properly.

It is pretty generally imagined that the smoking of ceilings is occasioned by impurity in the gas, whereas in this case there is no connection between the deposition of soot and the quality of the gas. The evil arises either from the flame being raised so high that some of its forked points give out smoke, or more frequently from a careless mode of lighting. If, when lighting lamps, the stopcock be opened suddenly, and a burst of gas be permitted to escape *before* the match be applied to light it, then a strong puff follows the lighting of each burner, and a cloud of black smoke rises to the ceiling. This, in many houses and shops, is repeated daily, and the inevitable consequence is a blackened ceiling. In some well-regulated houses, the glasses are taken off and wiped every day, and before they are put on again, *the match is applied to the lip of the burner, and the stopcock cautiously opened, so that no more gas escapes than is sufficient to make a ring of blue flame;* the glasses being then put on quite straight, the stopcocks are gently turned, until the flames stand at three inches high. When this is done, few chimney-glasses will be broken, and the ceilings will not be blackened for years.

Gas-fitters and lamp-makers generally put the stopcocks in situations where it is difficut to get at them, and they make their heads so small that, if they be in the least degree stiff, it is not easy to turn them gradually; hence, when a little force is applied, they move by starts, and the flame is sometimes raised too high, or, instead of being a little lowered, is altogether extinguished. The remedy for this inconvenience is to make the cocks easily accessible to a person standing on the floor, and to make their levers so long that their movements may be easily graduated. The cocks and levers may easily be designed so as to form part of the ornamental work of the lamps.

The argand burner being the most perfect and economical which can be used, unless where small portions of light are required, it is unnecessary to say any thing of the bat-wings and other fancy burners, especially as the only precaution to be taken with them, is to take care not to raise them so high as to smoke, and never to use two or more low flames, when the same degree of light can be got from one flame burning at its most effective height.

A mode of supplying argand burners with a current of heated air has been lately proposed in Paris, and much praised in London. This is effected by having an outer glass of a diameter a little larger than the inner one. This outer glass reaches farther down than the bottom of the burner, and is closed below by a metal plate; the air for the supply of the flame is made to pass down between the outer and inner glasses, where it gets heated: it then enters the inner glass and the centre aperture of the burner, and passing upwards, supports the combustion of the gas in the usual way. There is no doubt that, by this arrangement, a considerable improvement may be made in cases where ill-made burners, with wide and tall chimney-glasses are employed; but if the experiment be tried with burners and glasses proportioned in the way recommended above, it will be found that no advantage is gained, and that the maximum effect has been attained by a simpler apparatus.

Before quitting the subject of burners, it may be right to advert to a frequent cause of disappointment in their performance. The perfection of an argand burner is, *that the flame arising from it should appear in a continuous cylindric sheet, with a smooth upper edge, and without forking points.* This is sometimes very difficult of attainment, however carefully the jet-holes may be gauged by the pricker. There are two causes for this irregularity; one is, that, if the drill which is used be blunt, a little blaze is pushed aside by it when it is forced through the plate in which the jet holes are pierced; this blaze adheres to the edges of the hole, and interferes with the passage of the gas, and being unequal in its effects, renders the flame forked. The other cause is, that the inside of the burner is seldom turned true, and that the shoulder in which the pierced disk rests, is not of equal width all round, and sometimes may be so thick in some places, that the drill, when it gets through the disk, strikes against the shoulder; this likewise interferes with the issue of the gas. To avoid these causes of irregularity, the following precautions are essential. When the seat for the disk is turned out, the inside space between the inner and outer walls of the burner should be turned true for a quarter of an inch inwards, and no more shoulder should be left than just enough to support the disk in its place. The disk should then be put into its seat, but not finally fixed. The requisite number of holes should then be drilled in it, and slightly counter-sunk to take off the burb. The disk should then be reversed (that is to say, the counter-sunk face should be put inwards), and finally fixed in its place. The blaze which may have been pushed through with the drill will now be on the outside, and may be easily removed by the file, or by a slight counter-sinking, which is the preferable manner, as the smooth-edged holes will keep longer clean than those with a sharp arras, the application of an old tooth-brush being sufficient to keep them in good order.

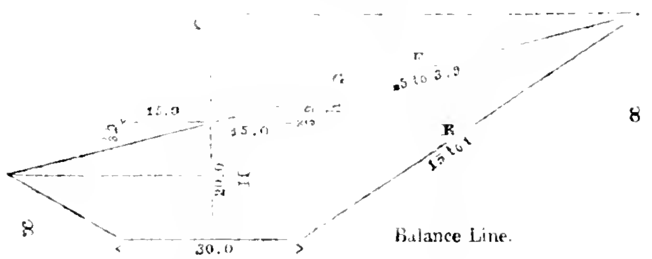
The above observations apply chiefly to the illumination of the interiors of buildings, and it may be proper to notice the circumstances which require to be attended to in lights which, being placed externally, are in some degree exposed to the weather. The most important of these are the street lamps. These may either be arranged at considerable distances, and be fitted with powerful burners, or the intervals between them may be smaller, and only a single jet be allowed for each. Various local considerations must determine this, as well as some other points: but it should be kept in mind, that the best small light is either the single jet of three inches and a half or four inches high, or the fish-tail jet of three inches high, and that for more powerful lights *the argand is preferable to all others*. The large bat-wing, so much used in large public lamps, is wasteful, smokes the lantern, and does not give light in proportion to its expenditure.

In most towns, framed square lanterns are used for street lamps, as it is said that globes are apt to be obscured in cold weather by the deposition of the water generated by the combustion of the gas. It is no doubt true, that if proper precautions be not taken, this inconvenience would be felt, and the water which would trickle from the aperture in the bottom of the globe would be liable to freeze in severe weather, and so to close up the access for air, that the lamp would smoke or go out. In all other respects, globes have undeniable advantages over framed lanterns, as they protect the flames better in high winds, and they are kept up at much less expense.

Some years ago I pointed out to the commissioners of police of this city, that advantage might be taken of the acknowledged good properties of the globes for lighting the streets, and the alleged defect be obviated by constructing the tin tops with chimneys which should reach down to the points of the flames, and by their current carry off the water while still in a state of vapour, and so prevent it from being condensed on the sides of the globes. This plan was immediately tried, and having been found successful, was adopted in all the lamps erected subsequently. It occasionally happens, that from the jet being deranged, the gas is directed past the tin chimney instead of into it, and if the weather be cold, it is immediately observed that a deposition of water takes place inside the globe, and its sides become dim. The adjustment of the burner restores the proper action, and the globe remains bright. This plan having now stood the test of many years experience, may safely be recommended for adoption wherever new street lamps are erected.

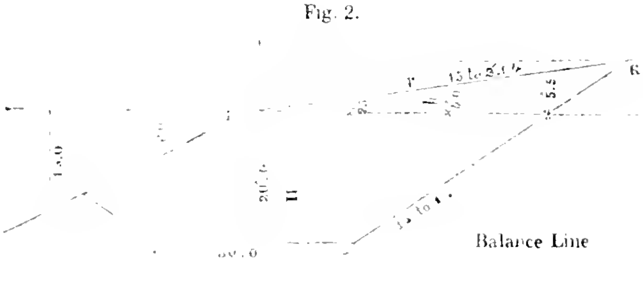
ON SETTING OUT RAILWAYS ON SIDELONG GROUND.

Fig. 1—Sidelong Ground.



C, centre line. G. surface of ground.

Fig. 2.



Sir—Should the following formulæ for setting out widths of railway land on sidelong ground be new, and in your opinion worth insertion, please to give them a place in your next number.

Suppose the centre line of way staked out and pegs driven into the ground at every chain's length, and further that levels have been taken at each of these lengths, both at the pegs and (in the case of a 30 feet base) at 15 feet horizontal distance on each side.

Then putting r for the rate of inclination of ground to a 15 feet length, R for the rate of inclination of slopes to a 15 feet length, H for height of balance line below or above surface at centre stake, h for difference of level between ground at centre peg, and at 15 feet on either side horizontal distance, and x for the actual height above or below balance line, at which the slopes run out to the surface.

We have $\frac{r}{R} x + H + h = x$ or $(H + h) R = R x - r x$ or the height above the balance line, at which the slope cuts out on the higher side.—1.

$\frac{r}{R} x + h + x = H$ or $H R - h R = r x + R x$, or the height above the balance line, at which the slope cuts out on the lower side.—2.

For example, in the case of a 20 feet cutting with base 30 feet, slopes 1½ to 1, and the surface of the ground varying in level from 3·9 feet above the centre peg,* at 15 feet on one side to 3·9 feet below at the same distance on the other side.

By formula 1, $(20 + 3{\cdot}9)\ 10 = 10\ x - 3{\cdot}9\ x$.

$239{\cdot}0 = 6{\cdot}1\ x$.

$39{\cdot}2 = x$ at 1½ 1 $= 58{\cdot}8, + 15 = 73{\cdot}8$.

73·8 horizontal distance to be set off from centre stake on higher side.

Again, by No. 2, $\overline{20 \times 10} - \overline{3{\cdot}9 \times 10} = 3{\cdot}9\ x - 10\ x$.

$161{\cdot} \quad = 13{\cdot}9\ x$.

$11{\cdot}5 \quad = x$.

At 1½ to 1 $= 17{\cdot}2 + 15 = 32{\cdot}25$ horizontal distance to be set off from centre stake on lower side.

It is here understood that these calculations are made in the evening after return from levelling, the depths of cuttings or embankments obtained by reference to a section run before hand over the centre line of way, and that the results of widths are pegged out on the following morning.

Another example is here added, in which the ground is shown as very irregular, although few instances occur to such an extent unless perhaps in Cornwall, &c. The depth of cutting and slopes with base same as before; levels supposed to be taken at A B C D on one side, and at E and F on the other. The extent of levels necessary must be left to the judgment of the party acting.

B 2·7	E = 8·
C 4·	F = 15·
D 5·5	
12·2 levels above A.	23· levels below A.

It is clear that in order to equalize the inclination of the surface, we must obtain a figure forming an arithmetical progression, in three terms to the amount of the higher side levels, but in two terms only to that of the lower.

Take 12·2 as before, of which 2·04 is the number required for the higher side inclination, and 23 of which 7·7 is the figure for the lower. Then according to our previous formulæ—

1. $(20 + 2{\cdot}04)\ 10 = 10\ x - 2{\cdot}04\ x$.

$220{\cdot}4 = 7{\cdot}96\ x$.

$27{\cdot}69 = x$ at 1½ to $1 - 41{\cdot}53 + 15 = 56{\cdot}53$.

56·53 to be set off as the horizontal distance from centre peg on higher side, correct ·9 of a foot.

Again No. 2. $\overline{20 \times 10} - \overline{7{\cdot}7 \times 10} = 7{\cdot}7\ x + 10\ x$.

$123{\cdot} \quad = 17{\cdot}7\ x$.

$6{\cdot}95 \quad = x$ at 1½ to $1 = 10{\cdot}42, + 15$.

$= 25{\cdot}42$ to be set off as the horizontal distance from centre peg for lower side.

I remain, your obedient servant,

Geo. B. W. Jackson.

Radcliffe Terrace, Goswell Road,
April 27, 1841.

* The centre peg in this case supposed to be level with ground.

Stone Cutting Machine.—The *Alsace* (Strazburg) states that a native of that town, named Muller, has invented a simple and cheap machine, set in motion by the force of a single dog, turning like a horse in a mill, whereby a stone in its roughest state is in five minutes cut into a regular shape fit for building, and its faces have an unusual smoothness. This machine is capable of working twelve stones in an hour, or 144 in a day of twelve hours, being equal to the labour of forty men employed for the same time. Muller (adds the journal) possesses several quarries of stone, both hard and soft, and works his mill daily in the presence of numerous spectators.

IMPROVEMENTS IN RAILWAYS AND THE WHEELS OF LOCOMOTIVE ENGINES AND CARRIAGES.

In the first place, the leading and trailing wheels of locomotive engines either with four or six wheels would work better were each wheel to be keyed upon a separate shaft, so as to revolve independently.* This may easily be done in the following manner: let the wheels be keyed upon their respective shafts in the usual way, with either outside or inside bearings, which ever may be the most convenient, and let the shafts have middle bearings to meet in the regulating line common to all. If the wheels and axles are made in this way, the wheels on the outside rail would revolve quicker than those on the inside, and would allow the engine to find its own bearings. This would be particularly evident in going round curves, and would be the means of preventing many accidents from engines being very liable to be thrown off the rails on those parts according to the present system. In the second place, it is proposed that each of the leading and trailing wheels shall be keyed upon a hollow shaft, in the usual way; these shafts to have no external bearings, but to be bushed with brass bored to fit the solid shaft, or spindles which will be required to work into them. The solid shafts to have a bearing at each end, and one in the middle if required. This plan will allow the outside and inside wheels to revolve independently on the curves or otherwise, and will also prevent them wearing irregularly. Should any obstacle be thrown in the way of the engine, the wheels revolving separately would prevent it from coming off the rails, as the wheels would act as a check to each other, or as a complete check or guard rail on any part of the line as hereafter explained.

Thirdly. The wheels to be made of either wrought or cast iron, (the latter would be preferable,) and to have a flange on each side, by which plan they would not be required so strong as those now in use, because they would take the lateral concussions or side jolts more equally than the present kind. Should the engine be thrown to one side, both wheels would take an equal share of the strain or jolt, whereas in the present system the wheels on one side take the whole strain. This properly adjusted, the conical wheels may be dispensed with, as well as the check or guide rails upon the whole line, which latter checks are a great nuisance. In the plan thus proposed the rails would be laid level or horizontally across and not at an angle as at present, and the wheels would have to be the segment of a circle† upon the face, in place of being conical. Each wheel would thus act as a check rail for the other during the whole of the journey. Should the rails be out of gauge so as to cause the wheels on one side of the engine to mount upon their flanges, and throw the train off the rails, as is very often the case with the present system, the double flanges would obviate this evil and keep the engine in its proper course, until the wheels again found their places. The switches will remain without alteration, but the points may be altogether dispensed with. By this method of working, there will be a great saving in the wear and tear of the engines and rails, it will reduce the cost of keeping the engines and road in repair, and lessen the friction, as well as the quantity of fuel with all other expenses in like proportion. In constructing the permanent way much time might be saved, as no attention will be required in laying the rails to an angle, as they would then be horizontal where the road itself is straight. Giving to the outside rails the proper rise in the curves, the angle of the two rails will incline both one way, and not reverse to each other as at present. This will afford the engine another mechanical advantage on the curves, giving gravity a much greater opportunity of acting against the momentum of the machine. The engine will also be kept in its proper course in the curves much more forcibly than is afforded by the present method of laying railroads by the present system, as the angles of the two rails are acting against each other, the outsides of both being higher than the insides, and causing a great friction upon the axles, brasses, wheels, and rails; this the proposed alteration will entirely obviate. All the conical wheels now in use, through concussions and constant rolling upon the rails, squeeze out on one side. No conical wheels retain their proper form much longer than two months if daily at work: each wheel causes the flange of the opposite wheel to act with great force on the inside of the rail, and *vice versa*. The large hollow inlet that is left in the angle of the flanges of the wheels crushes down the inside angle or corner of the rails; which the proposed wheels would obviate—the weight of the vehicle would be also much better distributed over the surface of the rails. This alone is a great inducement to the introduction of double flanged wheels on loose axles, as the rails would last double the length of time.

In the fourth place, the double flanges would prevent the wheels squeezing out, as they seldom squeeze out on the side next the flange, and being all made from cast iron, there would be no spreading. The longitudinal shake or clearance that is generally given to the axles in their brasses will not be required, as the action of each being entirely in itself, and inclosed in brass, will retain the oil much longer and not require that attention which the present do. Were the engines and carriages made according to this arrangement the loss of power in the curves would not exceed from 8 to 10 per cent. above that used on a straight line, always of course depending on the radius of the curves.

In the fifth place, the whole of the engine and tender wheels should be furnished with double flanges, the latter to be of different diameters; causing thus different depths from the face of the wheel to the tops of those flanges. The reason of this will be easily explained.

Railways at present are nothing but a series of complication of curves, all differing in intensity. To carry engines round those continually changing curves without trailing and great friction, would require wheels of greater and less diameters, and this difficulty I propose to surmount by means of those flanges, which will become *bona fide* for the time the wheels of the machine.

To enable me to make use of the above arrangements, I propose to have radiated plates or segments put down on each side of the main rail, at such a depth from the face of the rail, as to cause the wheels to be lifted from the rail, and allow the flanges to act on those segments; the machine rolling at one time on the large flange, at another time on the small, and from thence on the face of the wheel, those alternations of course depending on the nature and radius of the curve. The length and position of those segments would be found by a calculation depending on the intensity of the curves.

Were engines, carriages, &c., provided with such wheels, and the railways with segments to suit, it would be next to impossible for the train to leave the line of road; for, even supposing the whole of the tires on one side were to come off, the train would be kept in its course by the double flanges of the wheels on the opposite side. At present if a single tire comes off, the engine is precipitated from the rails, and if without any more serious result, the train is detained till the arrival of another engine, train, or other means of locomotion.

I may in addition mention that the fatal accidents arising from furious driving which is more or less practised on all lines, and is a terror to all travellers who have not the iron nerves of his Grace the Duke, would be altogether prevented; for not even the velocity of 100 miles per hour could force the engine or carriages off the line, so firmly would the wheels be bound to the rails, and so sweetly would they glide round the curves if made on the above construction.

With many apologies for intruding my ideas on your acquaintance,

I am, your obedient servant,

WILLIAM ANDREWS.

Paddington, March 26, 1841.

P.S. Were the wheels and segments calculated for each other, the parting or cutting of the shafts could be dispensed with, and they might remain just as they are at present.

W. A.

* Our correspondent will find that Mr Coles has anticipated him, if he refers to the Journal for April last, where he will see a method of making the wheels revolve independently of each other.—Ed.

† Wheels with concave rims were used on the Penrhyn Iron Railway. See Repertory of Arts, &c., for 1803, page 285.—Ed.

MR. MUSHET'S PAPERS ON IRON AND STEEL.—No. 2.

Sir—It is my intention in this letter to make a few remarks on the latter part of the paragraph in Dr. Ure's dictionary alluded to in my former letter) in which he says "the incorrectness of Mushet's statement becomes most manifest when we see the white lamellar cast iron melted in a crucible lined with charcoal take no increase of weight, while the gray cast iron, treated in the same manner, becomes considerably heavier."

This remark is as inapplicable to my table of proportions as the remark made in the former part of the paragraph. My experiments were confined solely to the changes produced in the character of iron by the fusion, not of cast iron, but of bar or malleable iron in contact with certain quantities of charcoal.

I have no where professed to account for the reason why that while white cast iron when fused alone with charcoal does not increase in weight, gray cast iron does, nor have I any where either asserted or denied that the fact is as stated by Dr. Ure, and I cannot help thinking that it is unfair in that gentleman, to raise up objections which have no foundation except in his own imagination, in order to throw them at what he calls my statement.

In my former letter the difficulty of obtaining an increase of weight in fusing cast iron alone with charcoal, is accounted for by the great fusibility of that kind of iron which, before the high temperature necessary for the exertion of the greatest force of affinity, can be raised upon it as a solid, occasions it to pass into the fluid state, in which no union can take place between it and the carbon.

The table of proportions, as has been already observed, is a simple recapitulation of the results of the fusion of bar iron with given quantities of charcoal to exhibit the various states and qualities of cast iron and cast steel. By these results it appears that less charcoal is required to form white cast iron than to constitute gray cast iron, and, after forty years' observation and experience this is still my decided opinion. Dr. Ure on the contrary thinks that common white pig iron contains a maximum dose of carbon and that the grayest pig iron of the blast furnace contains less. Hence it may be inferred (according to the reasoning of Dr. Ure,) that white cast iron when fused with charcoal, does *not* increase in weight, because it is already so saturated with carbon as to be unable to take up any more, and that gray cast iron, when fused in the same way, *does* increase in weight, because it contains a comparatively small quantity of carbon, and can therefore absorb an extra dose in its fusion with charcoal; but in what quantity this absorption takes place, or to what extent, the reader is left to guess.

Dr. Ure, following Karsten, says that white pig iron contains from 4½ to 5¼ per cent. of carbon, and gray iron from 3½ to 4 per cent., but the gray iron may, according to Dr. Ure, be considerably increased in weight by its fusion with charcoal. If we suppose this increase of weight to be from 2 to 2½ per cent. (from experiment I know it may be more), then we shall have, for the quantity of carbon in gray cast iron, the original quantity, from 3½ to 4 per cent., and the experimental quantity from 2 to 2½ per cent., making from 5½ to 6½ per cent. a proportion exceeding the maximum quantity assigned by Dr. Ure to white cast iron.

The following remarks will throw a little light upon the subject, and enable us to explain the phenomena without having recourse either to the theory of Drs. Ure and Karsten, or to the expedient of impugning the accuracy of the table of proportions.

Were white pig iron of a definite character, manufactured under the same cinder and circumstances in the blast furnace, and found to contain at all times the same quantity of carbon, it might be possible to arrive at some certain conclusion as to the results to be obtained by its fusion with charcoal. But if we consider that the white cast iron, particularly of this country, is generally made accompanied by a black or blackish brown cinder, containing portions of unreduced iron, it will be obvious that we have to deal with an impure and imperfect state of the metal, varying in quality as the proportions of carbon, oxide of iron, or earthy matter be absent or predominant. Hence the great difficulty of stating any thing definite on the subject, or of arriving at any satisfactory result, as we may use many different sorts of white pig iron, more or less pure, and containing more or less carbon to deal with.

By those who, like myself, have entered largely into this field of investigation, white cast iron has been estimated to contain from 1½ to 2 per cent. of carbon, (and not from 4½ to 5¼ per cent., as Dr. Ure has it,) together with a fraction of the unreduced ore and its accompanying earthy parts in combination with the iron, even when its fracture appears to be the most dense. The existence of these impurities is made most obvious in fusing white and gray cast iron in crucibles, and observing their molten surfaces respectively. The white iron, according to the degree of its impurity, presents upon its surface a quantity of slaggy matter, varying from ½ to 2 per cent. on the weight of the iron, while, under similar circumstances as to fusion, the gray cast iron exhibits a pure convex surface without a trace of slag.

Again in the cementation of white cast iron by heating it in contact with charcoal, with a view to convert it into gray iron, should the process be interrupted after a few hours' exposure, the surface of the iron will be found covered with minute hemispheres of slag of various diameters (but none of them exceeding half a tenth of an inch), opaque, containing iron, and easily displaced. At a more advanced stage of the cementation, the hemispheres of slag will be found to have parted with their iron, to have become more brittle and transparent, and to cover small globules of iron which (as evidence of the reduction of the metallic oxide united to the iron before alluded to) have inserted themselves on the surface of the bar. When white cast iron with a polished surface is used in a similar experiment, the hemispheres of slag and globules of iron do not make their appearance, but oozings take place which form themselves into highly magnetic matters with a specular surface, adhering partly to the iron and partly found in the charcoal, from whence they are easily withdrawn by means of a magnet.

It seems obvious from these facts, that a portion of weight may be thus lost (namely the oxygen of the oxide and the glass which has been disentangled from the metal by a process of incessant reduction), sufficient to account for white or lamellar pig iron, or some sorts of it, not increasing in weight when fused in contact with charcoal, in as much as the sum by weight of the oxygen, an unreduced but separated oxide and earth, may equal, or amount to more than, the carbon absorbed during the operation, and make it appear not only that no increase takes place, but that actual loss is sustained without calling into question the disposition which white cast iron may have to absorb or repel carbon in its fusion with charcoal.

Were it possible to obtain white cast iron as free from oxide and earthy matter as gray iron, and were it to be found on experiment that such iron gains no weight by its fusion with charcoal, while gray iron does, I should be inclined in some measure to account for this (as in my former letter) by the early fusibility of the metal, and from its being a more rapid conductor of heat than gray iron, which causes it to enter into fusion before an absorbing affinity can be instituted between it and the charcoal, while the latter, being a worse conductor, remains longer as a solid in a high temperature to absorb the carbon. Some sorts of white cast iron pass into gray iron in the crucible with facility, but not with any material augmentation of weight, the oxygen, oxide, and earthy matters lost being equivalent to the carbon gained. In other white pig iron I have experienced a decided increase of weight, while its fracture remained apparently unaltered, but more frequently when the white iron was changed to gray.

The same anomalies attach to the scale of manufacture. Different ores tend, according to their constituent parts to produce various qualities of iron as to their degree of carbonization, and some, when smelted alone, uniformly produce white iron.

These various shades of quality all vanish in the crucible through the application and medium of lime, to which is to be added as much argillaceous schist only as will convert the lime into a pure porcelain slag. Fusion under these circumstances, and with $\frac{1}{80}$ the weight of iron of charcoal, will convert the most imperfect white cast iron into the most beautiful carburet, equal in point of saturation of carbon to any thing that can be produced in the reduction of iron ores in the crucible, and superior to any thing that is produced from the blast furnace. Under the most favourable circumstances, the increase of weight in these cases seldom exceeds ½ per cent., while the same experiment made with gray iron would acquire an additional weight of from 2 to 2¾ per cent., clearly indicating the loss which is sustained in the fusion of white iron from the causes before mentioned.

Your's, &c.,

D. Mushet.

Coleford, April 27, 1841.

QUERIES.

Sir—I should feel obliged if you, or any of your numerous correspondents could afford me any information on the subject of the instruments and machinery, which have been at various times invented for the purpose of assisting and facilitating draughtsmen in the correct delineation of existing buildings, under different titles, as the Camera Lucida, Perspective Machine, &c.; many improvements have of late years been made in this department, and it is of these that I wish to obtain information. And I cannot help thinking that it is far from being an unimportant subject to the profession, as it tends greatly to facilitate one great object of travel to the architect, viz., the obtaining of strictly correct delineations of the different structures which may fall under his notice, with the least possible waste of time. In conclusion, I hope that gentlemen may be induced to furnish the names, &c. of any instruments of this description they may have seen, in order that their relative value may be known, as it has often happened in this profession as in others, that inferior and inadequate instruments have been employed merely through ignorance of the existence of better. Hoping that you will pardon my troubling you.

I am, Sir, your humble servant,

Archt. Angl.

Sir—If any of your readers could give me information on the following subject, I should be obliged to them.

How is the permanent way laid on the Greenwich arches? what is the cost of keeping it in repair? what thickness is there of ballasting between the rail and the extrados of the arch at the crown? and what is the cause of the feeling of rigidity, and of the jolting complained of on that line?

How are these points arranged on the Manchester and Birmingham, and other lines, where a railway is carried for a considerable distance on arches?

The comparative advantages of these methods, with any suggestions respecting them, will oblige

Your obedient servant,

May 3, 1841. A. B.

STEAM NAVIGATION IN AMERICA.

Written by Francis Anthony Chevalier de Gerstner, during his sojourn in the United States, in 1839.

[From the *Journal of the Franklin Institute.*]

1. *History and extent of Steam Navigation.*

Fulton, the North American inventor of steam navigation, constructed, in the year 1807, the first steam boat upon the Hudson river, to make regular trips between New York and Albany. The voyage of 145 miles was then performed in 33 hours. The success of this enterprise laid the foundation of steam navigation in the United States.

Up to that time the barks upon the Ohio and Mississipi were propelled partly by sails, partly by oars and poles; from Cincinnati to New Orleans (1600 miles), such a bark came down in five weeks, and went up in 80 to 90 days; for its management nine men were required down, and 24 to 32 up stream. In March, 1811, the first steam boat built by Fulton, in Pittsburgh, called the *New Orleans*, was launched on the Ohio, and commenced in December of the same year, to make regular trips between Natchez and New Orleans. The time required to make the trip of 300 miles between the two places was three days down stream, and seven to eight days up. The boat performed in a year only 13 trips up and down, or 7800 miles. A passenger paid 18 dollars for a passage down, and 25 dollars for one up stream.

Fulton constructed several other steam boats in the United States. He afterwards went to Europe, to bring into execution there, his important invention; but he found no encouragement in England, and when he proposed in Paris the introduction of steam navigation, he was derided by the French, and Napoleon declared him an adventurer. Five years elapsed, before Bell, in 1812, constructed the first steam boat at Glasgow, in Scotland. Steam navigation now came more and more into practice in Europe, but has as yet not attained such an extent there as in the United States, (except England.)

On the 6th of May, 1817, the first steam boat, the *Enterprize*, went up the Mississippi and Ohio, from New Orleans to Louisville, and arrived there on the 30th of May, or in 25 days. As the barks at that time required nearly three months for the same journey, the inhabitants of Louisville were in such an ecstacy, that they conducted the Captain Shrive, around in triumph, and gave him a public dinner. The steam boats upon the western and south-western waters were now constantly increasing in number, and in 1834, they counted already 234; in the year 1838, their number rose to 400. In 1831, there passed through the Louisville and Portland canal, in the State of Kentucky, 406 steam boats, and 421 flat boats, with a tonnage together of 76,323; in the year 1837, passed through the same canal, 1501 steam boats, and only 165 flat boats, with a tonnage together of 242,374.

In the year 1818, the first steam boat was launched on the great north-western lakes; in 1835, they were navigated by 25 steam boats, and in 1838, the number of steam boats was 70. In the year 1834, 88 new steam boats were built in the United States; in 1837, or three years after, 134 new steam boats were launched. The largest ship-yards for building steam-boats, are at New York, Philadelphia, Baltimore; at Louisville, New Albany, Cincinnati, Pittsburgh, and St. Louis.

In total, there were in the summer of 1838, about 800 steam boats in operation in the United States; the greatest number, in any one State, belonging to New York, viz., 140.

The travel in steam boats along the sea-shore has, as I observed in my former letters, been mostly superseded by railroads, located in a more or less parallel direction to the sea coast; and will, probably, when the whole railroad system is completed, entirely cease; but the steam navigation upon the navigable rivers is getting more into practice; its increase in the last two or three years, has contributed much to diminish the navigation with sailing vessels or barks; not only all kinds of merchandise without exception, but also provisions, as grain, flour, meat, &c., are carried in steam boats as well up as down stream, and while the freightage is almost the same as upon the barks and sailing vessels, the goods arrive much sooner at the place of their destination if carried in steam boats, and are, therefore, less liable to be damaged. But still more has been done. Upon the Ohio river, stone coals are now brought by steam boats, 250 miles, down to Cincinnati, or rather the flat boats, loaded with coal, are taken in tow and brought down the river by steam boats, and the empty barks taken back in the same way, because the cost of transportation is found to be less in this manner. It is true, the extremely high wages of the boatmen and all other labourers, contribute much to this extraordinary result; but, as I shall have occasion to show, hereafter, the crew of a steam boat is also very well paid, and it is to be ascribed entirely to the perfection in the construction of vessels and the engines used in them, and in the application of steam, as also to the improved arrangements in the steam boats generally, that they have produced in America the results which have been arrived at neither in England nor in any other part of Europe.

The Americans boast of a system of navigable streams in the southern and south-western states not to be met with in any other country of the globe; they maintain that the length of the Mississippi, with the Ohio and all other tributary streams, comprises an extent of 100,000 miles of water navigable by steam boats. I would not answer for the correctness of this number, but the Mississippi alone is navigated by steam boats from New Orleans, under the thirtieth degree, to the Falls of St. Anthony, under the 45th degree of north latitude, a distance not less than 2000 miles, and the number of navigable tributary streams of the Mississippi is indeed so large, that an European, who is accustomed to our short travels by steam boats, can only, by being an eye witness, conceive the magnitude of the system of steam navigation in this country. There are daily, at least four or five steam boats starting from New Orleans for Pittsburgh, in the business season, and as many arrive daily; the distance is 2000 miles, or two-thirds of that from England to New York across the Atlantic, and nevertheless the voyage is regarded as nothing extraordinary, and is undertaken after a few hours preparation.

2. *Construction of Steam Boats and the Engines used therein.*

The steam boats in America, with the steam engines used in the same, are of three entirely different plans of construction. Those upon the eastern waters, comprising the sea along the coast of Boston to Charleston, S. C., and all rivers emptying into the same, have condensing engines with large upright cylinders, and long strokes, the larger boats draw from five to seven feet water, and go with a speed of from ten to fifteen miles per hour. Upon the Hudson river, the distance from New York to Albany, of 145 miles, is performed in eleven to twelve hours up stream, and in nine to ten hours down stream, including the stoppages at fifteen or twenty landing places, where passengers come on board or leave the boat. I took a passage in the steam boat, *North America*, on the 23rd of November, 1838, from New York for Albany; as the river was already nearly half frozen over, a great deal of floating ice was coming down; the boat left New York at five o'clock in the evening, and arrived at Albany the following morning at seven o'clock; we made, therefore, including all stoppages, over ten miles per hour up stream. The length of the vessel is 200 feet, greatest width 26 feet; she has two decks, the lower of which, where the engines are, is about three feet above the level of the water; she has two separate cabins, the gentlemen's cabin, which is, at the same time, the dining room, and the ladies' cabin. We had 320 passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain, one may imagine how colossal this floating palace must be. Two steam engines with 52 inch cylinders, move the paddle wheels of 22 feet in diameter. The pressure of the steam of this, as of most of the steam boats upon the eastern waters, is about fifteen pounds per square inch, and the stroke eight to ten feet; the steam is generally cut off at one-third or one-half of the stroke, and operates by expansion. For a voyage of 145 miles, 25 to 30 cords (of 128 cubic feet) of soft wood are required. The *North America* draws, when loaded, six feet; but there are passenger boats upon other rivers in the east which draw, when loaded, only 24 to 30 inches of water, and move against strong currents.

The steam boats in the west, or upon the "western waters," are, throughout, very flat, and go, when loaded, generally five feet deep, some, however, only thirty to thirty-six inches. When the water in a river is only thirty inches deep, the steam-boat contains only the engine and fuel, and the cabins for the men, and flat boats loaded with goods are taken in tow. The passenger boats have two decks, the upper one is for the cabin passengers. The elegant boats contain a large splendidly furnished and ornamental saloon, used as the dining-room, and an adjoining saloon for ladies. The saloons are surrounded by small apartments, (state rooms), each of which contains two berths, and round the state rooms is an open gallery, to which a door opens from each state room. Such a vessel offers to an European an imposing and entirely novel aspect. All steam-boats upon the western waters have high pressure engines, the pressure of steam being from 60 to 100 pounds per square inch. Often two engines are used in a boat, and then each engine propels one of the paddle-wheels. The cylinders are horizontal, the stroke is eight to ten feet, and the steam is generally cut off at five-eighths of the stroke, and then operates by expansion. The escaping steam is applied to heat the water pumped from the river, before it gets into the boiler.

The third kind of steam-boats is to be found upon the lakes in the north and north-west of the Union, they generally go much deeper than the former, are more strongly built, and are propelled partly by condensing and partly by high pressure steam-engines.

3. *Progress of Steam Navigation since its introduction in the United States*

The perfection attained in steam navigation may be estimated after a comparison of the former and present performances of steam-boats, and of the former and present rates of charges for transportation of passengers and merchandise.

In the year 1818, a cabin passenger paid for a passage in a steam-boat from New Orleans to Louisville, a distance of 1450 miles, 120 dollars, and for returning, 70 dollars, the passages up took twenty days, and down, ten days; at present, cabin passengers pay, in the most elegant steam-boats, 50 dollars for a passage up, and 40 dollars for one down stream; while they go up in six, and down in four days. These charges include boarding, which, considering the abundance and choice of the victuals, &c., ought to be estimated at two dollars per passenger per day. The fare is, therefore, now, for the passage alone, taking the average between a trip up and down, (excluding board), 2·41 cents per mile. Less elegant boats take cabin passengers up in eight days, for 30 dollars, and for 25 dollars down in five days, which, after deducting one and a half dollars per day for board, gives only 1·22 per mile, at an average between a trip up and down.

Upon the lower deck of these steam-boats, which is a few feet above the surface of the water, are the deck passengers, who provide their own meals, and pay for the same passage of 1450 miles, only eight dollars; if they assist

2 E 2

the crew [illegible] engaging [illegible] on the boat, they pay only five dollars. [illegible] former [illegible] they pay, [illegible] per mile, [illegible] cents.

Merchandize was carried, before the introduction of steam navigation, in sailing vessels, which took a load of 150 tons; in the year 1817, the charge for freight per pound, from New Orleans to Louisville, was seven to eight cents; in 1819, the steam-boats commenced carrying freight, and immediately reduced the charge to four cents per pound. At present, the charges per one hundred-weight, from New Orleans to Louisville, are according to the quality of the goods and the season, at least 33 cents, and at the most, one and a half dollars; at an average they may be taken at 6[illegible] cents for the distance of 1150 miles. This makes 0·6 cents per ton per mile.

Between Cincinnati and Louisville, the first steam-boat, *General Pike*, was put in operation in 1819, and made, weekly, a voyage down to Louisville, 150 miles, in eighteen hours, and up again to Cincinnati in forty hours. A cabin passenger paid at that time twelve dollars for a passage. At present, the steam-boats have so much increased in number, that at least six boats are daily starting from and arriving at Cincinnati or Louisville. Upon the finest boats, as, for instance, the *Pike* and *Franklin*, the fare is four dollars, and the time occupied in going up is, including all stoppages, fifteen hours, and in going down only eleven hours; but these boats have frequently made a passage up in twelve, and a passage down the river in seven and a quarter hours; in the latter case the speed was therefore over twenty miles per hour. If one dollar be deducted for board, there remain three dollars for the passage, which is at the rate of two cents per mile. The deck passengers who assist in taking in wood, pay only one dollar, or two thirds of a cent per mile and find their own victuals. For merchandize, the charges are fifteen cents per cwt., or two cents per ton per mile.

From Cincinnati to St. Louis, the voyage is 538 miles down the Ohio, and 192 miles up the Mississipi river, making together 730 miles. The passage to St. Louis, or from there back, is performed in four days. A cabin passenger pays twelve dollars, of which we ought to deduct at least four dollars and seventy cents for board, this leaves only one cent per mile for the passage only. The deck passengers pay four dollars without board, which makes nearly one half cent per mile. Goods pay, at an average, 50 cents per one hundred weight, 1·37 cents per ton per mile.

Upon the Hudson river, the passage fare is, in the most elegant boats, three dollars for the distance of 115 miles between New York and Albany, which gives two cents per passenger per mile; for meals an extra charge is made. In less elegant steam boats, passengers are carried the same distance for one dollar, and at this moment even for 50 cents, which gives only one-third of a cent per mile.

From the above data we may infer that, at an average, cabin passengers upon the American rivers pay according to the elegance of the steam boats, from two and a half cents down to one cent per mile (board not included), and deck passengers only about one half cent per mile; both travel, taking the average between up and down stream, with a speed of 12 miles per hour. Goods upon the same steam boats are carried, at an average, for one and one-third cents per ton per mile.

These striking results, which are attained nowhere else, are chiefly derived from the improvements constantly made in the construction of the boats and their engines. Of the 800 steam boats at present navigating the American waters, hardly two will be found of an entirely similar construction; the steam engines, though subject to the same principles of steam power, differ from the English in nearly all their parts. But three years ago, eight days were required for a trip from New Orleans to Louisville, which is now regularly performed in six. The most remarkable result is, that a boat of 400 tons required, 20 years ago, for this voyage of 1150 miles, 360 cords of wood, while at present, for a six days passage only, the same quantity of wood is required.

4. *Rise of Wages, and of the Prices of all Requisites for Steam Boats during the last year.*

What appears most striking, is, that while the charges for transportation have been constantly reduced during 20 years, wages and the prices of all commodities rose from year to year. The captain of a steam boat received 20 years ago, a salary of 1000 dollars per year, now he gets, upon the better boats, 2000 dollars. Every steam boat has two pilots, who change every four hours; each of them received, in 1822, only 60 dollars a month, but since that time their salary has risen, and was, in 1833, 300 dollars, which is still now paid to the pilots of the best boats; there are also two engineers upon each steam boat, their salary was, in 1822, only 40 dollars per month, and rose in consequence of the great demand for engineers, to 100 and 150 dollars. The firemen and common labourers received, 20 years ago, only 11 dollars per month, and get now 30 to 40 dollars. The whole crew, besides, have free board upon the steam boats.

The provisions necessary for the nourishment of the passengers upon the steam boats, have risen in price during the last five years, 33 per cent.

The steam boats upon the western waters use, almost exclusively, wood as fuel for the engines, which, 20 years ago, was quite valueless; in 1834, it sold on the Ohio and Mississippi, for $1\frac{3}{4}$ to 2 dollars per cord, and costs at present $2\frac{1}{2}$ to $3\frac{1}{2}$ dollars; the price has therefore increased in the last five years, about 50 per cent.

5. *Cost of Steam Boats.*

The steam boats upon the western waters, whose plan of construction might be adopted to great advantage upon our rivers in Europe, are, as I observed already, principally constructed in Louisville, Cincinnati, and Pittsburgh. In general, the hull of the vessel is built by ship carpenters, the steam engine delivered from a manufactory, and put on the boat, after which the joiners build the cabins and finish the whole. Three different classes of mechanics are therefore required, with whom separate contracts are made; there are, however, individuals who undertake the building and furnishing of a whole steamer by contract. As the prices differ much according to the solidity and elegance of the vessels, I herewith state the cost of some of the steam boats, which are among the best.

Between Cincinnati and Louisville, the two steam boats, the *Pike* and *Franklin*, make regular trips, carrying the United States mail; one of the two goes daily up, the other down, the river. The *Franklin* is 183 feet in length at her deck, and the extreme width is 25 feet, the depth of hold, or the distance from the keel to lower deck, is $6\frac{1}{2}$ feet. The tonnage 200 tons. Upon the upper deck are 42 state rooms, each with two berths, making, in all, 84 berths; but mattrasses are laid upon the floor of the dining room, when required, and 150 cabin passengers may sleep upon the boat. The boat is propelled by two engines, the pressure of steam is *eighty pounds per square inch*, the diameter of the cylinders, which are in a horizontal position, is $25\frac{1}{2}$ inches, the stroke seven feet. The steam is cut off at $\frac{1}{3}$ of the stroke, and acts through the remaining $\frac{2}{3}$ by expansion. The diameter of the paddle wheels is 22 feet, their width 11 feet, the dip is 22 inches, the paddle wheels generally make 28 revolutions in a minute. The length of the connecting rod is 23 feet. There are six boilers of wrought iron on board the boat, each 23 feet in length, and 40 inches in diameter, each boiler has two flues of 15 inches diameter.

At an average, the steam boat carries 125 passengers, one half in the cabins, and the other half on deck, and besides 25 tons of goods. With this load she draws six feet water. The boat was constructed in the year 1836, and the cost was :—

	Dollars.
For the hull, at twenty-five dollars per ton........	5,000
— two steam engines	12,000
— joiners' work for cabins	4,000
— draperies, mirrors, bedding, and other furniture in the state rooms, saloons and kitchen	9,000
Total	30,000

This boat is, as observed, one of the most solid and elegant; other steam boats of the same dimensions have cost 5600 dollars less.

Amongst the steam boats of the largest class, which run only between New Orleans and Louisville, the *Sultana* and the *Ambassador*, are now much favoured by the public; the *Ambassador* has 215 feet length of deck, and 35 feet extreme breadth. Her tonnage is 450. On the upper deck are 44 state rooms, each with two berths, but as many beds may be arranged upon the floors of the saloons. Of the two steam engines, each has a horizontal cylinder of 25 inches diameter and eight feet stroke; the steam acts with a pressure of *ninety pounds per square inch*, and is cut off at $\frac{1}{3}$ of the stroke. The diameter of the paddle wheels is 22 feet, their width 12 feet. The boat generally carries 200 tons of goods up, and 300 tons down stream, besides 100 cabin and 150 deck passengers; she draws, empty, five feet, and when loaded, seven feet water. The hull of this boat has cost 12,000 dollars, the engines 17,000, the joiners' work, and the whole inner arrangement of this highly elegant structure, amounted to 31,000 dollars, making the cost of the whole boat 60,000 dollars. It must, however, be observed that great and costly alterations were made during the construction, so that her cost would actually not exceed 55,000 dollars.

Well instructed individuals, who are very much interested in the subject of steam navigation, estimate the average cost of a steam boat upon the eastern waters, at 45,000 to 50,000 dollars, upon the western waters, after a special calculation, at 23,500 dollars, and upon the lakes, the average between the two, or at 35,000 dollars. Consequently all the steam boats, which were in operation in 1838, have cost as follows, viz.

				dollars.
351	boats upon the eastern waters, at	....	47,500	16,672,500
385	ditto	western....................	23,500	9,047,500
64	ditto	lakes,.....................	35,000	2,240,000
800	steam boats, each at an average cost of	....	34,950	27,960,000

Now, as since the introduction of steam navigation, 1,300 steam boats were built in the United States; the whole capital invested by the Americans in steam boats, amounts to 45,135,000 dollars, the greater portion of which has been expended in the last five years.

(To be continued.)

New Motive Power for River Navigation.—A Brussels paper announces the arrival in that city of Dr. Beck, the inventor of the plan for navigating the most rapid rivers against the stream by means of a motive power that is represented to be without limits in its operation, and in which he uses neither steam nor wind power, nor hauling from the banks. It is stated that M. Wagner, of Franckfort, the inventor of the application of electro magnetic power to navigate boats, &c., Dr. Brttger, president of the Physical Society of Franckfort, M. Pauli, the first royal engineer of Bavaria, and many other distinguished scientific men, have proved by experiment the great advantages of this important invention.

ON WARMING BUILDINGS WITH HOT WATER.

An Answer to Messrs. J. Davies and G. V. Ryder's Report on Perkins' System of Warming Buildings by Hot Water. (See the Journal for April last, page 137.) By A. M. Perkins.

The excitement that has been occasioned by the destruction of Messrs. Craft and Stell's premises in Manchester, by fire, arising from the bursting of the furnace-coil of a hot water apparatus, on "Perkins' system of warming buildings by means of hot water," and the measures taken in consequence by the Manchester Assurance Company, have created an alarm as to the general safety of his plan, which the patentee feels it incumbent upon him to show is unfounded, and to prove that whenever accident has occurred, it may in every case be traced, either to the improper construction of the apparatus in the first instance, or to carelessness and mismanagement in the use of it. It appears by a report which has been extensively circulated by the Manchester Assurance Company, that a committee of the Directors of that company was appointed "to inquire into the nature of the accidents which have recently occurred from the use of hot water apparatuses, and to report thereon;" in pursuance of which resolution Mr. John Davies and Mr. George Vardon Ryder were directed "to institute a personal investigation into some of the cases referred to, and to make such experiments as might tend to satisfy their minds as to the causes of the accidents which had occurred."

In the report presented by these gentlemen to the directors, they commence by describing "the appearances observed" at some of the places which they visited. These appearances consisted of "wood, matting, and cushions, in a variety of places contiguous to the hot water pipes, having been charred to an alarming extent," and that Mr. Barbour's warehouse had "been on fire, *close to the pipes*, at different times and in different places." The Unitarian Chapel in Strangeways, also showed marked "appearances," the floor being charred black, and at the Natural History Museum in Peter Street, the matting on the floor had been charred, and the floor itself appears to have been scorched. The whole of these appearances were produced by one and the same cause—the overheating of the pipes; and this was doubtless occasioned by the disproportion of the furnace-grate and draught to the furnace-coil, like that erected upon Mr. Walker's own premises, for the purpose of Messrs. Davies and Ryder's experiments. Mr. Rawthorne's communication respecting the Strangeways Chapel affords sufficient evidence of an ill-proportion and ill-constructed apparatus, the deficiency of heat, great consumption of fuel, offensive scent, and charred wood, are convincing proofs that the quantity of tubing laid down in the chapel was insufficient to afford a proper supply of warmth; and the endeavour to procure more heat by extra firing sufficiently accounts for the great consumption of fuel, and the offensive scent given out by the pipes when thus overheated. In an apparatus justly proportioned, the water circulating in the pipes can receive but a given quantity of heat, and any fuel added beyond that point would not cause them to become overheated. It is necessary here to describe what "Perkins' system of warming" really is; for the patentee utterly disclaims the apparatus experimented upon by Messrs. Davies and Ryder as his, any further than that the pipes were closed in all parts.

Perkins' apparatus, then, consists of a continuous or endless tube, closed in all parts, a portion of which is coiled and placed within a *duly proportioned* furnace: from this coil the rest of the apparatus receives its heat by the circulation of the hot water flowing from its upper part, and which, cooling in its progress through the building, returns into the lowest part of the coil to be reheated. The expansion of the water, when heated, is fully provided for by the expansion tube, which is of three inches diameter, and of sufficient length to afford an expansion space of from fifteen to twenty per cent; this, long practice has proved, is ample for the greatest heat which can be attained by the water, as it expands only five per cent. from 40°, its point of greatest density, to 212°, the boiling point. This tube is placed at the highest part of the apparatus, and is empty when the water is cold; the furnace is provided with a damper, by which the fire may be regulated at pleasure. In a well managed apparatus this damper is in general nearly closed after the fire has become well ignited, and the draught is so regulated that little more than a slumbering fire is kept up, which at once economises fuel and prevents the possibility of the pipes being overheated. The degree to which the damper should be closed depends entirely upon the goodness of the draught; and a very few days'—even a few hours' experience will show the person in charge of the apparatus the point at which it is desirable to keep it. To most of the apparatuses recently erected by the patentee, a self-regulating damper has been attached, acting from the expansion and contraction of the pipe: when this becomes heated beyond any given point to which the damper has been previously regulated, the elongation of the pipe by the excess of heat acting upon the handle of the damper, partially closes it; the draught is thus checked and the fire lowered; the pipe consequently cools, and, in cooling, contracts; the contraction again opens the damper and the fire is revived. By this action of the self-regulating damper any degree of heat from the pipes may be maintained within a few degrees; if the damper be so fixed as to work the apparatus at 250°, it will be found that the heat of the pipes will range between 255° and 245°, whatever quantity of fuel may be thrown upon the fire; thus again the overheating of the pipes is effectually prevented, and an equal temperature at the same time obtained.

In the arrangement and fixing of any apparatus, regard ought always to be had (as has been already stated) to the due proportions of grate surface, heating surface, conducting and radiating surface, and draught; and where these have been duly observed, accident becomes impossible, even if the damper should be left wide open. It is not deemed necessary here to state the proportions the above surfaces should bear to each other, but their necessity is sufficiently obvious; an unlimited supply of heat arising from an excess of fire or heating surface and draught, with a limited means of carrying off that heat, must cause overheating somewhere, as is proved by the high temperature of the apparatuses at Birch Chapel, Mr. Barbour's Warehouse, the Strangeways Chapel, and the Natural History Museum; while, on the other hand, the due observance of these proportions renders an apparatus upon this system perfectly safe. Nor can it be considered that, in claiming attention to the foregoing points in constructing an apparatus, the patentee demands too much; it is the duty of every tradesman who undertakes to erect these apparatuses to understand them; and to such an one what has been said presents no difficulties; and surely common care and the usual degree of prudence required from every person attending upon fires may reasonably be asked for in the management of a hot water apparatus.

After this brief description of what a hot water apparatus erected upon Perkins' system ought to be, it is necessary now to examine whether the apparatus erected in Mr. Walker's premises, and experimented upon by Messrs. Davies and Ryder, is to be considered as an apparatus upon Perkins' system, and what degree of weight ought to be attached to experiments conducted as they were, and upon such an apparatus. It appears from the report of those gentlemen, that it consisted of 140 feet of tubing, of which 26 feet were coiled in the furnace. With these proportions of tubing no fault is found; but it seems from the diagram annexed to the report, that only 15 inches of expansion tube was attached to it (at least only that quantity was left unfilled with water), which, supposing it to be of three inches diameter, the largest size used, is six inches less than the apparatus required. This, in so small an apparatus, is a serious difference when worked at a very high temperature; still, however, under ordinary circumstances, the apparatus would have worked. The *damper* is not once mentioned in the report, nor does it appear that it was ever made the slightest use of during the experiments, so that the full force of the draught was admitted to the furnace at all times unchecked, even when it was loaded with fuel to repletion. This might suit the purpose of those who erected this apparatus with the express view of making it as dangerous as air, fire, and water, recklessly employed, could make it; but what tradesman would introduce one so constructed into his employer's premises? But more could yet be done to increase the dangerous tendency of this apparatus; and, accordingly, in the absence of Mr. Walker, a stop-cock was introduced, which, cutting off the greater part of the circulation, left only *forty feet of the tubing* out of the furnace, to carry off all the heat that could be communicated from *twenty-six feet within it*, with a fire out of all proportion to those surfaces, and a draught totally unchecked. With the apparatus in this state—a state in which no man in his senses ever before thought of working one, and which, it may be safely asserted, had never before occurred since the introduction of warming by hot water—preparations were made for an explosion. The process of "igniting," "destroying," "fusing," "inflaming," and "charring," various substances, went on most prosperously, and, at length, the desired explosion took place, the fire was thrown violently out of the furnace, and the ignited embers were scattered in profusion over every part of the place. Some gray calicos spread around the furnace were alone wanting to complete the scene, and put the finishing touch to this exquisite specimen of "Perkins' Hot-water Apparatus."

But can it be seriously intended that an apparatus thus erected, and thus worked, is to prove the *danger*, and caution the public against the use of Perkins' system of warming by means of hot water? Is the abuse of a thing to be used as an argument for discontinuing the use of it? To what invention will not such reasoning apply? Steam-engines, railways, all must vanish before it, since, if great skill and care are not employed in their construction, and much caution and prudence in their application, they become imminently dangerous.

Messrs. Craft and Stell's premises were burnt down; the fire was caused by the bursting of the furnace coil of the hot-water apparatus, which threw the ignited embers among combustible materials, and set them on fire. But was common precaution used in placing the furnace in such an apartment (the very walls of which were boards), and in surrounding it with grey goods? Would not a vault or a cellar have been a more appropriate place? and had the furnace been so situated, would the premises have been destroyed by the explosion which took place? This explosion was caused by a stoppage in the pipes; the water in them was frozen. It appears the warehouse was closed on Saturday evening, and not opened again before Monday morning; the frost being intense during the two intervening nights. A fire lighted in the furnace on Sunday morning was an obvious means of preventing such an occurrence; and it might have been supposed would have naturally suggested itself. Weather of such extreme severity is not very frequent in England, and the short time required for such a purpose (the necessity of it being evident) could scarcely be considered a desecration of the day. And even after the pipes were frozen up, common attention on the part of the fireman would have shown him the circumstance in a few minutes after the fire was lighted; the want of any circulation in the pipes being always indicated by their great heat near the furnace and their coldness in every other part. Had the fire then been raked out and the most exposed part of the pipes been thawed by the application of heat to them externally, the circulation might have been restored, and all would have been well. No precautions, however, of any kind appear to have been taken, and the endeavour to force a circulation in the state the pipes were then in, produced the disastrous event that ensued. It is not the object of the patentee to throw blame upon others, he only wishes to show that his apparatus may be used with perfect safety, if the same care and attention be bestowed upon it, as is required by every other mode of warming.

There are some palpable errors in the report of Messrs. Davies and Ryder in their remarks upon the inequality of the heat given out by the pipes in the Natural History Museum, and the manner in which they attempt to account for it. They observe, that the heat in those pipes had been repeatedly stated to become the greatest at places remote from the furnace, and that the fact was confimed by their own observations and subsequent experiments: and in another part of the Report they account for it by stating, that the minute bubbles of steam which rise rapidly to the upper part of the flow-pipe become there condensed into water again. From this acknowledged fact they deduce the inference that, "as condensed steam wherever it occurs produces about seven times as much heat as the same quantity of water at the same temperature, we have at once a reason for the heat of the pipe being generally greater at a distance from the furnace than contiguous to it." This is a manifest absurdity, for it is impossible that increase of heat can be produced by the condensation or cooling of steam. There cannot, therefore, be the slightest doubt that the statement of those gentlemen, that the heat is generally greater at points distant from the furnace than contiguous to it, is founded altogether in misconception and error. Another observation from which erroneous conclusions are drawn is, that the temperature of the pipes is influenced by the variation of their internal diameter, this is not the case; the amount of heat conducted off depends upon the surface exposed to the atmosphere, and not upon the internal diameter. Equal surfaces exposed to the atmosphere give off equal heat, whatever variation there may be in the velocity of the current of the water within the tubes.

The objection No. 1, relative to the possibility of an explosion from the inadequacy of the expansion tube, has been already met in the description of the apparatus in the former part of this paper; and overfilling the apparatus is impossible while the filling-pipe is made the only medium of supplying it, and the screw-plug of the expansion tube is at the time of filling taken off.

In objection No. 2, it is inferred that, because a pint of water may be converted into steam capable of exerting a powerful mechanical force, and present a pressure upon the tubes "sufficient to ensure their destruction," that such must inevitably be the case. Ten years' experience has, however, proved the contrary; any quantity of steam which can be formed in an apparatus properly put up, the tubes are perfectly able to resist.

Objection No. 3 supposes the presence of hydrogen gas in the apparatus to be a common occurrence, instead of a very rare one; and where it has occurred it has invariably arisen either from a faulty construction of the apparatus, or great neglect in its management. Admitting, however, that hydrogen gas has been formed within the pipes, no explosion can be produced by its expansion, as its expansive power is far less than that of water; neither can it explode within the pipes by ignition, as it requires an admixture of atmospheric air to render it explosive.

The remaining objection urged against the use of the apparatus is, the danger of explosion from stoppage in the pipes. This is a very unusual occurrence, and rarely happens except in seasons of very severe frost, when it may always be prevented by keeping a slumbering fire. The addition of three per cent. of salt to the water will also prevent it from freezing, even during such severe weather as was experienced last winter. The objection of stoppages by extraneous substances getting into the pipes, is scarcely worth notice; the last operation of the workmen in erecting a new apparatus is always to scour the pipes well through by means of a forcing pump, and then to close them up. How then can any substances get into pipes thus closed in every part, except by design?

It seems that previously to putting up the apparatus at Mr. Walker's, those at the Natural History Museum, and Messrs. Vernon and Company's, had been tried and found "unsatisfactory;" that is to say, they could not be sufficiently overheated. The patentee can show Messrs. Davies and Ryder some hundreds of apparatuses that would prove still more "*unsatisfactory*" to them than those just named. Since the foregoing remarks were written, Mr. Perkins has received a letter from Sir Robert Smirke, in which that gentleman says, "I am sorry to know that you think the partial use of my answers to the questions sent to me from Manchester (as printed in the Report there) has been in any degree prejudicial. If it has been so, I think you ought in the reply you are about to publish, to counteract that effect, especially as it was one not at all intended. They should, at least, have directed equal attention to my remark that complete security, under every contingency, might be obtained from the adoption of your safety-valves."

Comment upon this is unnecessary; it only strengthens the feeling which the perusal of Messrs. Davies and Ryder's Report has very generally produced, viz. that it is very unjust, and that the absurd experiments detailed in it were conducted with any view rather than that of candid investigation.

If those who possess the means of obtaining the information would make known the causes of all the fires that have come under their cognizance within the last eight or ten years, as far as they can be ascertained, the patentee is confident that such a statement would speak more in favour of his apparatus than the most laboured arguments. There are not wanting, however, many persons even in Manchester itself, who, placing more confidence in their own knowledge of the apparatus, founded on several years' experience, than in the Report, have unhesitatingly expressed their determination to continue the use of it as heretofore.

The safety-valves, alluded to by Sir Robert Smirke, have been but recently applied; and effectually provide for any casualty which can arise from a stoppage in the pipes.

In conclusion, the Patentee begs that the Directors of Assurance Companies, and the public generally, will not hastily form their opinion of Perkins' hot-water apparatus from the very erroneous reports which have been circulated respecting it, as it is his intention to request a committee of competent gentlemen connected with insurance offices to inspect an *apparatus properly constructed*, and which he *wishes* to have subjected to any test to which such committee may think proper to submit it.

6, *Francis Street, Regent Square,*
April 10*th*, 1841.

LOCOMOTIVE ENGINES IN AMERICA.

We have received a copy of the Annual Report of the Canal Commissioners of Pennsylvania. Among the documents thereto appended, is the report of the superintendent of motive power on the Philadelphia and Columbia railroad, in which an engine built by Mr. Ross Winans, of this city, is spoken of in the most flattering terms, which applies not only to the particular engine, but to the class of engines built by Mr. Winans. We extract the following from the report:—"In addition to the different engines of the ordinary construction purchased by the undersigned, is one built by Ross Winans, of Baltimore, which, as well as others, was contracted for by a resolution of the Board, previous to the date of my last report. The general principle upon which this engine is constructed is similar to the one which, by the order of my predecessor, had been placed on the road near a year before my appointment. It is, however, entirely different in its proportions.

"This engine was constructed by special orders, as an experiment in the use of anthracite coal as a fuel to generate steam; and, on trial, has met all my anticipations. It is very large and heavy, with more than double the power of any other machine on the road. It burns anthracite coal exclusively, and from the additional space of fire-box, obtained by its increased size, has advantages in the use of that article, which is not, and which cannot be possessed by any other plan of engine. It is intended exclusively for the transportation of heavy trains of burthen cars. It will haul double the ordinary train, but owing to its great weight, must be run very slowly over the road."

We have understood that this engine rests its entire weight on *four propelling* wheels, each wheel supporting about the same weight as each one of the *two propelling* wheels of the largest class six wheel engines on the Philadelphia and Columbia road. The engine last built by Mr. Winans, and which we have before noticed, is still more powerful than the one spoken of in the report; but having overcome the difficulty that has heretofore been deemed insurmountable, of placing eight wheels under his engine, and connecting the motive power with all of them, so as to get the adhesion of the entire weight, without having a weight on any one wheel which is oppressive to the road. The engine now furnished weighs 19·33 tons, when in running condition, and is mounted on eight propelling wheels, which divide the weight equally among them, putting 2·42 on each wheel. The passenger engines of Norris' construction, in such extensive use, weigh about 10 tons when in running condition; but as they have only two propelling wheels, the greatest adhesion which they can render available, is that resulting from 6·70 tons resting on the driving wheels, which is but little more than one-third the adhesion obtained by Mr. Winans' eight wheel engine, while the weight on each driving wheel of the Norris is 3·35 tons, nearly a ton more than the weight on each wheel of the eight wheel engine. The power of every locomotive engine is limited by the greatest adhesion of its wheels on the rails; the adhesion is directly as the weight resting on the propelling wheels collectively. The greater the weight bearing on any one wheel the more destructive to the road. The greatest economy in transportation results from the use of the most powerful engines that can be employed consistent with the strength and character of the road on which they are to run; hence the advantage of increasing the number of propelling wheels.

An account was published a few days since, in a Philadelphia paper, of a gross load of 481½ tons being drawn over the Philadelphia and Reading Railroad, by an engine built by Messrs. Baldwin, Vail and Hufty, the weight of which is stated to be 11·92 tons, and the weight on the driving wheels 6·30 tons. As this is less than one-third the weight on the driving wheels of Mr. Winans' eight wheel engine, which has been shown to work to the full extent of its adhesion, it follows that it would be capable of taking over the Reading road three times the amount of the load above-named.—*Baltimore Clipper.*

The Railway Guard's Whistle.—Upon one of the London and Birmingham trains an apparatus is fitted up, consisting of rods attached to every carriage, and under the control of the guard, communicating with a whistle on the engine, called the "guard's whistle," quite distinct from the one sounded by the driver, and used only to give warning to him, to increase or decrease his speed, to stop, &c., according to signals previously a ranged and understood.—*Yorkshire Gazette*.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

February 9.—The PRESIDENT in the Chair.

Mr. S. Seaward explained the Table of Velocities of steam ships, which accompanied his paper. (See Journal for last month, page 168.)

The top line of figures represents the number of horses power, ranging from thirty to three hundred. The side line gives the tonnage of the steam ships, rising progressively from one hundred to twelve hundred tons. The intermediate spaces show the number of knots or nautical miles, which a ship of given tonnage, with a certain power, will travel through still water per hour.

The tonnage is calculated by the old rule (13 George III. cap. 74): "From the length substract $\frac{3}{5}$ths of the breadth, multiply that sum by the extreme breadth in the widest part, and again by $\frac{1}{2}$ the breadth, divide the product by 94, and the quotient will be the true tonnage."

The Table is constructed upon the principle, that each vessel of a good modern form will carry, at a proper draught, a weight equal to her measurement tonnage, and is presumed to be loaded equal to her tonnage, either by the weight of her engines, fuel or cargo, and it terminates at thirteen knots, at which speed the engines alone become the full load of the ship. The mode of constructing and of using the table was fully described, and examples were given.

It was shown, that an engine of thirty horses power would propel a ship of twelve hundred tons burthen, at the rate of 4 knots per hour, while three hundred horses power would only propel the same ship at the rate of $10\frac{2}{3}$ knots per hour. Hence, ten times the power would only produce about two and a half times the speed.

The principal points in the paper were more fully dwelt upon, and in answer to questions from some of the members, Mr. Seaward remarked, that no steamer in England had ever been propelled at more than fifteen geographical miles per hour, through still water.

In some of the Government mail packets, the engines and coals were the full cargo of the vessel. The table did not apply to vessels overladen with power, for as the weight increased in the ratio of the power, so the immersed sectional area was augmented, and the lines of the vessel which might be well calculated for speed when at a proper draught, became lines of retardation, and the engines did not work up to their proper speed, owing to the depth to which the paddle floats were immersed. For instance:—The wheels of the "British Queen" have been plunged between six and seven feet, instead of four feet, which was the calculated dip; the engines at the same time diminishing their speed so much as to reduce the effective power from five hundred horses to nearly three hundred horses.

The only advantageous way in which great power could be applied, would be by contriving to prevent the increase in the weight of the machinery and fuel, and those engineers, would be most successful who could so apply the materials of construction, as to ensure strength without the usual corresponding increase of weight.

Mr. George Mills, from his experience as a ship-builder, at Glasgow, was enabled to confirm all that Mr. Seaward had advanced. On the Clyde, the employment of an excess of power in steam vessels had been carried to the greatest extent, without producing corresponding advantages, either for speed, or in a commercial point of view. It would appear that the same error had to a certain degree been committed on the Thames, but less than on the Clyde; for on the latter river there were vessels with nearly double the power, in proportion to size, as compared with any vessel on the former river. He believed that on the Thames no vessels had so much as one horse power for each register ton, whereas on the Clyde, there were steamers of seventy to eighty tons register, having single engines, with cylinders of fifty-four inches diameter, which was more than one hundred horses power. It would appear that this application of extra power had only obtained a very moderate speed, while the great first outlay, with the commensurate current expenses, had reduced the commercial profit to the lowest point,—of this the proprietors alone could give any account; but as to the speed attained, he had seen three steamers of identical tonnage leave the Broomielaw at the same time, their engines being respectively of one hundred and ten, eighty, and sixty horses power; yet their speed was in the inverse ratio of their power: the vessel with the smallest engine arrived at Greenock first, the greater power second, and the greatest last. These remarks were only applicable to river boats. With regard to sea-going vessels, the system had not been carried to so serious an extent, yet with them the average proportion was about one horse power to two register tons, and some few reached as high as one horse to one and one-eighth of a ton.

As an example of an augmentation of power producing an opposite result from that which was intended, Mr. Mills mentioned two vessels called the "*Tartar*" and the "*Rover*," built by him and his (then) partner, Mr. Charles Wood. They were each of about two hundred and twenty tons register, built from the same draught, and in every respect as similar as possible—except that the engines, which were by the same maker, were respectively of one hundred and seventy, and one hundred and thirty horses power; yet whenever they worked together, the one with the smaller power proved herself the faster vessel, either in a calm, with the wind, or even against it. The "*Achilles*," Liverpool steamer, which lately had an addition of thirty feet to her length, and eighteen inches to her breadth, augmenting the tonnage about one-fifth, had improved her speed upwards of one mile per hour, although she carried a much heavier cargo than before.

He had built a vessel of five hundred and sixty tons register, with engines of one hundred and thirty horses power on board—a proportion of power to tonnage of one to four; the stowage for cargo was ample; the accommodations for passengers excellent. She drew little water, and her speed was much greater than vessels of double her power. Yet in spite of all this, the vessel could not find a purchaser, because the power was not nominally large.

It would be asked—why, with these and so many similar instances, such a system was continued? It was not likely that the engineers would complain of having orders for large engines; and there were certain dimensions prescribed for the vessel, to which the ship-builder was under the necessity of conforming.

The chief cause of mischief, however, was the fiat of the public. It was believed that a great power would remedy want of speed and all other evils, and it was found indispensable for ensuring the confidence of travellers. Hence, the shipowners, who depend upon the public for support, were obliged, against the conviction of their experience, to keep up the errors occasioned by ignorance.

The President observed, that the condemnation of large power should not be carried too far, as experience alone had produced the increase of weight, strength, and power, of the present engines, compared with those of the early steamers which were built, instancing the *Halifax Packets* (Cunard's), which, with their great power in proportion to tonnage, had performed their duties satisfactorily.

Mr. Mills explained that the Halifax Packets were built for the especial purpose of carrying the mails only, to perform the voyage in a given time,—about twelve days. The engines were built by Mr. Robert Napier, after the model of those of the "Great Western," which used their steam expansively; similar provisions had been made in the Halifax Packets, but the expansion valves were seldom used.

Mr. Field agreed with the principal part of Mr. Seaward's paper, but he would prevent an erroneous conception of the term *overpowering* a steamer. A vessel could not have too much power, provided that power could be advantageously applied, without causing too deep an immersion. A good result could be produced only by keeping a proper proportion between the machinery, the vessel, and the paddle wheels, and immersing the hull of the steamer only as deep as the true lines of draught.

Mr. Vignoles observed, that in this country the reputation of engineers depended upon the commercial success of the works they engaged in. An erroneous public opinion might have influence at present; but if the engineer and ship-builder would determine to break these trammels, and produce such vessels as should force conviction upon the public mind by the speed attained, and show the proprietors the consequent commercial advantage, the present system would soon be abandoned.

Mr. Parkes eulogized Mr. Seaward's candour in describing the errors in the first construction of the engine on board the Vernon; more was frequently to be learned from failures than from successful efforts, and no communications to the Institution would be so useful as those which gave accounts of defective design or construction, with the details of the methods adopted for remedying the defects. He directed attention to the performances of the "Great Western" steam ship, which at least equalled those of the Halifax Packets, without the disadvantages of being unable to carry cargo, or of shipping so much sea, when the weather was foul. The important feature of economy of fuel on board the "Great Western" might be in part attributed to the use of steam expansively. It was very desirable that the Institution should possess very full drawings and a description of the "Great Western," so as to be enabled to compare them with those of the Halifax Packets, which had been promised by Mr. George Mills. He would impress upon manufacturers of marine engines the necessity of adopting a correct and uniform nomenclature of the power placed on board steam vessels. The nominal sailing power did not accord with any calculation.

Mr. Field believed the Table of Velocities calculated by Mr. Seaward to be very nearly accurate. The speed of the "Great Western," when loaded to her proper draught, has been as high as $13\frac{8}{10}$th miles through still water. There was an error in the alleged speed of Cunard's vessels; they reached Halifax in ten days, Boston in three days more, and then had still one day's voyage to New York. The average duration of the voyages of the "Great Western," was about fourteen days and a half. If two hundred tons were deducted from the tonnage of the "Great Western" for cargo and the accommodation for the passengers, she would then be similar to the Halifax Packets. The engines of the "Great Western" were nominally estimated at four hundred horses power, and the average consumption of fuel was twenty-six tons every twenty-four hours.

During the discussion, Mr. Cubitt had calculated the following Table, showing the rates of velocity which would be attained by substituting engine power, with its consequent weight of one ton per horse power, for cargo, so as to preserve the draught of water the same in all cases.

Mr. Seaward remarked, that his Table of power and velocities was corroborated by Mr. Cubitt's—the practical results verified both. The great difference between the "Great Western" and the Halifax Packets consisted in the better adaptation of weight and power to tonnage, and the more economical consumption of fuel of the former over the latter—the one carrying cargo and passengers, the other only the engines and fuel, yet the "Great Western" travelled farther with the same quantity of fuel.

Table showing the power required to obtain various rates of speed in a steam vessel, where the total weight of cargo and engines remains in all cases the same, and in which, with a power of 30 horses, a speed of 5 miles per hour is obtained; the total weight carried being in all cases 1000 tons, and the engines weighing 1 ton per horse power.

Weight of Cargo.	Weight and Power in Tons and Horse Power.	Relative speed.	Speed in miles per hour.
970	30	$5\sqrt[3]{1}$	5·
940	60	$5\sqrt[3]{2}$	6·299
910	90	$5\sqrt[3]{3}$	7·211
880	120	$5\sqrt[3]{4}$	7·937
850	150	$5\sqrt[3]{5}$	8·549
820	180	$5\sqrt[3]{6}$	9·085
790	210	$5\sqrt[3]{7}$	9·564
760	240	$5\sqrt[3]{8}$	10·
730	270	$5\sqrt[3]{9}$	10·4
700	300	$5\sqrt[3]{10}$	10·772
670	330	$5\sqrt[3]{11}$	11·119
640	360	$5\sqrt[3]{12}$	11·487
610	390	$5\sqrt[3]{13}$	11·756
580	420	$5\sqrt[3]{14}$	12·050
550	450	$5\sqrt[3]{15}$	12·331
520	480	$5\sqrt[3]{16}$	12·599
490	510	$5\sqrt[3]{17}$	12·856
460	540	$5\sqrt[3]{18}$	13·103
430	570	$5\sqrt[3]{19}$	13·34
400	600	$5\sqrt[3]{20}$	13·572
370	630	$5\sqrt[3]{21}$	13·794
340	660	$5\sqrt[3]{22}$	14·01
310	690	$5\sqrt[3]{23}$	14·219
280	720	$5\sqrt[3]{24}$	14·422
250	750	$5\sqrt[3]{25}$	14·62
220	780	$5\sqrt[3]{26}$	14·812
190	810	$5\sqrt[3]{27}$	15·
160	840	$5\sqrt[3]{28}$	15·182
130	870	$5\sqrt[3]{29}$	15·3615
100	900	$5\sqrt[3]{30}$	15·535
70	930	$5\sqrt[3]{31}$	15·706
40	960	$5\sqrt[3]{32}$	15·854
16	990	$5\sqrt[3]{33}$	16·037

In answer to a question relative to American steam boats, he believed that the build of the river steamers was very peculiar: some of them had engines of 600 horses power on board, yet they drew only four feet of water, whereas a sea-going steamer with that power would draw at least 16 feet. As far as he could ascertain, the actual well-authenticated speed did not exceed 14½ geographical miles per hour through still water. The fuel consumed could not be ascertained, as it was chiefly wood, taken on board at the places of stoppage; there was a great consumption of steam at a very high pressure. Their machinery was not heavy, and was specially adapted to the vessels. Daily improvements were making in the form of vessels in England, and when high pressure steam and light engines were applied to vessels of a different form from those at present constructed, the speed must be increased. Some vessels were now building on the Thames of an extremely light construction, with tubular boilers, and the weight of the machinery would be only eleven cwt. per horse power.

February 16.—The President in the Chair.

The following were balloted for and elected: William Radford, Henry Alexander, John Gandell, William Bagnall, Thomas Bagnall, and James Bagnall, as Associates.

"*Practical Observations on the management of a Locomotive Engine.*" By Charles Hutton Gregory, Grad. Inst. C.E.

The working of a railway involves a number of practical details with which it is of great importance that the young engineer should make himself thoroughly acquainted. Of these, one of the most important is the management of a locomotive engine.

The communication consists of practical remarks on this subject from the author's individual experience; it is divided into three sections:—1st. The management of an engine in the Station. 2nd. On the Road. 3rd. In cases of accident.

Section 1st—contains instructions as to the state in which an engine should be kept in the station, and a detailed account of the examination to which it should be subjected previously to its starting with a train. The principal working parts are mentioned, with the particular attention due to each; and the proper supplies of oil, coke, and water, enumerated. The section concludes with a list of the articles necessary to be carried on the tender.

Section 2nd—enters fully into the leading points of engine driving. After attending to the precautions to be taken in starting, the author points out the proper position of the engineman, and the attention which he should give to the state of the rails, the safety of the train, and the working of the engine. Instructions are then given for the production and maintenance of a sufficiency of steam, by the judicious management of *water* and *fuel*. The proper height of the water in the boiler is described both under general and particular circumstances, and the times at which it should be supplied: with observations on priming, on the action of the pumps, and their irregularities.

This is followed by remarks on the proper manner of supplying coke, the extent and periods of that supply, the proper height of the coke in the fire box, &c.

Instructions are given for economizing and rendering the steam most efficient; the mode of treatment to be adopted in case of extraordinary deficiency or excess; rules for stopping and starting at the stations; general hints in case of the wheels slipping, and of the heating of the axles; precautionary measures to be adopted on curves, steep inclines, dangerous parts of the road, &c.; the care necessary for an engine at the end of each journey, and when finishing its work for the day.

Section 3rd—describes those accidents to which engines are most liable when running, and the steps to be taken under the circumstances: viz.—The bursting of a tube, the lagging of the boiler catching fire, the failing of the feed pumps, the breaking of an axle, of a spring, or of the connecting rod, the disconnexion of the piston, of the eccentrics, or any of the slide valve gear, the fracture of the strap of the slide valve, and the engine running off the rails.

"*Observations on the effect of wind on the suspension bridge over the Menai Strait, more especially with reference to the injuries which its roadways sustained during the storm of January* 1839." By W. A. Provis, M. Inst. C.E.

In the month of December 1825, when the original construction of the bridge was nearly completed, several severe gales occurred, and considerable motion was observed, both in the main chains and in the platform of the carriage ways. It appeared that the chains were not acted upon simultaneously, nor with equal intensity; it was believed, therefore, that if they were attached to each other, and retained in parallel plains, the total amount of movement would be diminished.

On the 30th of January, and on the 6th of February, 1826, some heavy gales again caused considerable motion of the chains and roadway, breaking several of the vertical suspending rods, and of the iron bearers of the platform.

These bearers were constructed of wrought iron bars, overlapping each other, and bolted together, with the ends of the suspending rods between them, for the purpose of giving stiffness to the structure. The flooring planks were bolted to the bearers, and notched to fit closely round the suspending rods, which were thereby held almost immoveably in the platform.

It was observed, that the character of the motion of the platform was not that of simple undulation, as had been anticipated, but the movement of the undulatory wave was oblique, both with respect to the lines of the bearers, and to the general direction of the bridge. It appeared, that when the summit of the wave was at a given point on the windward side, it was not collateral with it on the leeward side, but, in relation to the flow of the wave, considerably behind it, and forming a diagonal line of wave across the platform.

The tendency of this undulation was, therefore, to bend the bearers into a form produced by the oblique intersection of a vertical plane with the surface of the moving wave. The bearers were not calculated to resist a strain of this nature: they therefore were fractured generally through the eyes on each side of the centre foot-path, at the point of junction with the suspending rods, which being bent backward and forwards where they were held fast at the surface of the roadway, were in many instances wrenched asunder also.

The means adopted for repairing these injuries, and for preventing the recurrence of them, were, placing a stirrup, with a broad sole, beneath each of the fractured bearers, attaching it by an eye to the suspending rod, cutting away the planking for an inch around the rods, and at the same time bolting, transversely, to the underside of the roadway, an oak plank, fifteen feet long, between each two bearers, for the purpose of giving to the platform a greater degree of stiffness, combined with elasticity, than it previously possessed. The four lines of main chains were also connected by wrought iron bolts passing through the joint plates, and traversing hollow cast iron distance pieces, placed horizontally between the chains.

The effects of these alterations were so beneficial, that little or no injury occurred for nearly ten years. On the 23rd of January, 1836, a more than usually severe gale caused violent undulation of the platform, and broke several rods. There can be little doubt that ten years' constant friction, combined with the shrinking of the timber, had relaxed the stiffness of the platform, and permitted an increased degree of undulation. The gate-keeper described the extreme amount of rise and fall of the roadway in a heavy gale to be not less than sixteen feet; the greatest amount of motion being about half way between the pyramids and the centre of the bridge.

In consequence of the injuries sustained during this gale, the author and Mr. Rhodes were instructed to give in a report upon the state of the bridge, and on any repairs or additions which might appear desirable.

The result of the examination was satisfactory; the whole of the masonry, the main chains, their attachments to the rock, the rollers and iron work upon the pyramids, and all the principal parts of the bridge, were as perfect as when first constructed; it was, however, recommended, that "a greater degree of rigidity should be given to the roadways, so that they should not bend so easily under vertical pressure."

The bridge remained in the same state until the hurricane of the 6th and 7th of January, 1839; during the night of the 6th, all approach to the bridge was impracticable; the bridge-keeper, however, ascertained that the roadways were partially destroyed; and he in consequence traversed the strait in a boat in time to prevent the down mail from London driving on to the bridge.

When the day broke, it was found that the centre foot-path alone remained entire, while both the carriage ways were fractured in several places. The suspending rods appeared to have suffered the greatest amount of injury; out of the total number of 444, rather more than one-third were torn asunder; one piece, 175 feet long, of the N.E. carriage way, was hanging down and flapping in the wind; much of the parapet railing was broken away; the ties and distance pieces between the main chains were destroyed; the chains had resisted well in spite of the violent oscillation they had been subjected to, to such an extent, as to beat them together and strike the heads off bolts of three inches diameter.

Means were immediately adopted for restoring the roadways; and so rapidly was this effected, that in five days carriages and horses passed over, while foot passengers were not at any time prevented from crossing.

The account of the restoration of the bridge, communicated by Mr. Maude to the Institution, is then alluded to.

The substance of the report of the author to the Commissioners of Her Majesty's Woods is then given, and a review of the proposals made by Mr. Comms, Colonel Pasley, and others, relative to the restoration.

The opinion of Colonel Pasley, "that all the injuries which have occurred to the roadways of Suspension Bridges must have been caused by the violent action of the wind from below," is then examined, and reasons given for the author's dissent from that opinion.

The action of the wind upon the Conway and Hammersmith Bridges, is next examined; and from the amount of oscillation observed in all suspension bridges, the conclusion is arrived at, that winds act strongly and prejudicially on the fronts as well as on the horizontal surfaces of the platforms of suspension bridges, and that the effect of winds is modified and varied by the nature of the country, and the local circumstances connected with each individual bridge. Although differing in opinion with Colonel Pasley as to the general cause of injury to suspension bridges, the author agrees with him in the propriety of giving increased longitudinal rigidity to their platforms, to prevent or to restrict undulation. He advised its adoption in 1836, and applied his plan of stiffening by beams, in 1839. He preferred beams to trussed framing, on account of the facility with which the former could be increased in number, to obtain any requisite degree of stiffness, and because he feared that trussed frames could not always be kept firmly in their true vertical positions.

A drawing showing the injuries sustained by the platform during the hurricane of 1839, accompanied the communication.

Mr. Cowper was of opinion, that the real cause of injury to suspension bridges was the vibration of the chains and roadway. The whole suspended part, when acted upon by the wind, became in some measure a pendulum, and if the gusts of wind were to recur at measured intervals, according either with the vibration of the pendulum, or with any multiplies of it, such an amount of oscillation would ensue as must destroy the structure. He illustrated this proposition by a model with chains of different curves, and at the same time pointed out the efficiency of slight brace chains in checking the vibration.

Mr. Brunel agreed with Mr. Cowper in his opinion of the cause of injury to bridges, and with the propriety of applying brace chains, for preventing the vibration. He then alluded to the introduction of lateral braces in the bridge designed by Mr. Brunel, senior, for the Isle of Bourbon. He had been at the Menai Bridge during a severe storm, and had particularly noticed the vibration of the chains with the accompanying undulation of the platform. The force of the wind was not apparently from beneath; it appeared to act altogether laterally. The chains were too high above the roadway; their vibration commenced before the platform moved: the unequal lengths of the suspension rods then caused the undulating motion. His attention had latterly been much given to the subject on account of the Clifton Suspension Bridge, now erecting under his direction. The span would be seven hundred feet, and the height above the water about two hundred feet. He intended to apply the system of brace chains at a small angle to check vibration. To two fixed points in the face of one pyramid would be attached two chains, each describing a curve horizontally beneath the platform, touching respectively the opposite sides of the centre of the bridge, and thence extending to similar points on the other pyramid: there they were attached to two levers, the ends of which were connected with a counter balance of about four tons weight appended to each: these weights would hold the chains sufficiently extended to enable them to resist the lateral action of the strongest winds without their being so rigid as to endanger any part of the structure. By this contrivance the platform would be kept firm, which was the chief point to be attained.

In all suspension bridges the roadways had been made too flexible, and the slightest force was sufficient to cause vibration and undulation. The platform of the Clifton Bridge would have beneath it a complete system of trough-shaped triangular bracing, which would render it quite stiff. He was an advocate for bringing the main chains down to the platform, as at the Hammersmith Bridge, and for attaching the bearings to the chains at two points only; when they were suspended by four rods, it not unfrequently happened that the whole weight of a passing load was thrown upon the centre suspension rods, and the extremities of the bearers were lifted up and relieved from all pressure. The extent of the expansion and contraction of the chains was a point of importance. In the Menai Bridge the main chains on a summer day would be as much as sixteen inches longer than in a winter's night. At the Clifton Bridge the difference under similar circumstances would be about twenty inches. The whole expansion of the back chain beyond the pyramids must be thrown into the suspended part. He would prefer having only one chain on each side of the bridge, and that chain much stronger than is usually adopted, but in deference to public opinion he had put two; he believed that they rarely expanded equally, and hence an unequal distribution of the weight of the roadways upon the suspension rods occurred. A rigid platform would in some degree prevent this, but he had endeavoured to lessen the effects of unequal expansion by arranging a stirrup at the top of each suspending rod, so as to hold equally at all times upon both the chains, and thus cause each to sustain its proportion of the load.

Mr. Seaward had never seen the force of wind exerted at regular intervals, as Mr. Cowper had supposed; if the gusts were repeated at such intervals, no suspension bridge, nor any elevated shaft or chimney in masonry, could resist them.

Mr. Rendel believed that the errors committed in the construction of suspension bridges had principally arisen from engineers theorizing too much on the properties of the catenary curve, without attending sufficiently to the practical effects of wind in the peculiar localities in which the bridges were placed. He could not agree with Mr. Cowper in his view of the intermittent action of the wind, or the vibrating of the chains. Observation had led him to conclude that, in the positions in which suspension bridges were usually placed, the action of the wind was not uniform; for instance, it would act at the same moment on the upper side of one end of the roadway, and on the lower side at the other end. In this case, unless the platform possessed a certain degree of rigidity, undulation was induced and oscillation ensued. Braces and stays would not counteract this—nothing but a construction of platform, which made it in itself rigid by some mode of trussing, could withstand this kind of action. He agreed with Mr. Brunel in his idea of reducing the number of the suspending chains. At the Montrose Bridge, which was 432 feet span, he had endeavoured to avoid all complexity of contrivances by adopting a complete system of vertical diagonal trussing, which was ten feet deep—five feet above, and five feet below the platform—so as to insure rigidity, and to produce that solidity which was essential for preventing undulation and oscillation.

Mr. Cowper reverted to the motion which he had found to be so easily produced by repeatedly exerting a small force at measured intervals against the main chains of the Hammersmith Bridge. He conceived that if the chain oscillated, the roadway must oscillate also.

Mr. Rendel contended that the motion produced by the impulses communicated by Mr. Cowper to the chain resolved itself into undulation, and not oscillation. He could not understand the advantages of the trussing adopted at the Hammersmith Bridge: it appeared to him that its tendency was, on the passage of a heavy weight, to relieve four out of five of the suspending rods from their due proportion of the load, and to throw it upon the fifth rod. His object in the construction of the framing of such platforms had always been to spread the load quite equally, and rendering it rigid by means of vertical trussed framing, to prevent the undulation which was the primary cause of oscillation. He would distinguish clearly between the two motions, and say, that undulation was a motion in the direct line of the platform, and that oscillation was a motion at right angles with it. Vibration was identical with undulatory action.

Mr. Donkin conceived that a good system of trussed framing could alone prevent undulation or oscillation; if the framing were placed vertically, its tendency would be to prevent undulation; if placed horizontally, to prevent oscillation: now, as Mr. Rendel had given it as his opinion, that the latter action resulted from the former, the system of trussing adopted by him at the Montrose Bridge would appear calculated to obtain the desired end. A slight exertion of force would produce a perceptible undulation, and a certain degree of vibration would result from the natural elasticity of the materials.

Mr. Seaward remarked, that the degree of oscillation would appear to depend in some measure upon the distance at which the platform was suspended beneath the chains, and upon the distance between the points of suspension of the main chains; if the platform were rigidly held at the extremities, the motion would be vibratory, and not amounting to undulation.

The railway tickets on the Manchester and Leeds line, invented by Mr. Edmondson, are printed by a machine which gives each a progressive number, and arranges them in order. Two boys lately printed 10,000 tickets in four hours.

THE PRESIDENT'S CONVERSAZIONE.

The general conversazioné of Mr. Walker, the President of the Institution of Civil Engineers, took place on Wednesday evening, 12th ult., and was distinguished by the same features of interest which always render this one of the most remarkable reunions of the season. The suite of rooms was embellished by works of art of almost every class, extending from the production of the golden age of art, down to those of the aspirants of the present day. Amongst other objects of this description, which were scattered in profusion through the spacious though crowded area, we particularly noticed several admirable busts by Park, Belines, and Smith, together with one of the host himself, modelled in clay by Mr. J. E. Jones, an amateur whose talents, if he had not already chosen a profession in life, would certainly entitle him to shine in this department of art. The portfolios of drawings by Varley, Hering, Tomkins, Fripp, and Kendrick, and the paintings by Scanlan and John Wood, excited great attention, and elicited corresponding praise. A new etching by Thomas Landseer, the first proof of his brother Edwin's picture of Count d'Orsay's dog "laying down the law," was displayed amongst these objects of art. Nor ought the unrivalled vases and bronze figures, the work of the eccentric Florentine artist of the 15th century, of Clodion and others of later date, to be passed over in silence. There were also some of Goddard's fine Daguerréotypes, some electrotypes, as also some specimens of Cheverton's beautiful mechanical sculpture. The most striking of the useful novelties were samples of coloured glass from Mr. Apsley Pellatt's manufactory, some ornamented slabs, &c., of slate from Magnus's Pimlico works. Atkinson's patent ornamental wood mouldings, which are equal to carved work; Pole's new hygrometer. The principal feature, however, of Mr. Walker's soirée was the exhibition of models of machines, &c., which were, throughout the evening, the chief focus of attraction. It is impossible, within the limits of an ordinary notice, to afford any thing like an adequate epitome of the various ingenious and highly useful, as well as valuable, novelties which attracted the attention of the guests on all sides. The model of the lighthouse erected on the Maplin sands at the mouth of the Thames, by Mr. Walker himself, obtained very great attention, a description of which appeared in the last number of the Journal. Mr. Hicks' radial drilling machine, his compound hydraulic press, and new governor, &c. Messrs. Seawards' beautiful models of marine steam-engines, the slide-valves, the disconnecting apparatus for paddle-wheels, and the brine detector, Barnes' paddle-wheel, and the model of the Castor steamer. Mr. Dent's electric and central percussive clocks, Mr. Gossage's disc steam engine, Messrs. Whitworth's (of Manchester) street cleansing machine, cutting tools, &c., Messrs. Ransome & May's railway chairs, Dr. Schaffhaeutl's new universal photometer, a sectional drawing of the Thames Tunnel by Sir Isambart Brunel, and a vast assemblage of other beautiful adaptations of the chemical, electrical, and mechanical branches of science to the purposes of utility and ornament, excited the admiration and occupied the untired attention of the stream of visitors for several successive hours. The conversazioné was attended by most of the distinguished amateurs and professors of science and art, and notwithstanding the eventful debate in the House of Commons, which was proceeding at the same time, and which occupied all the peers and members of Parliament, and the Literary Fund dinner, which detained many of the usual visitors, the numbers who availed themselves of this opportunity of testifying their love of science and esteem for the distinguished President, was very great.

Among the company we noticed, besides the council and a large number of the members of the Institution, the chief members of almost all the scientific societies of the metropolis:—The Marquis of Chandos, Lord Hennecker. Admiral Adam, Barons Schleinitz and Bulow, Colonels Pasley, Maclean, Lieut. Colonels Blanshard, R.E., Hutchinson, Major Anderson, Sirs J. J. Guest, M.P., Frederick Pollock, M.P., Wm. Symons, John M'Neil, Isambart Brunel, George Murray, Walter Riddell, Henry Parnell, M.P. Edward Knatchbull, M.P., Chas. Price, Harry Verney, M.P., John Scott Lillie, Chevalier Benkhausen, Captains Laird, Ivanetskey, Locke, Willis, Scanlan, Pringle, R. Wellbank, L. Price, Kincaid, Smith, G. Smith, R.N., Evans, R.N., R. Drew, Drs. Paris, Schaffhaeutl, Elliot, Field, Pollock, Arnott, Walker, Billing, Roget, Bowring, Rigbey, Reid, Professor Willis, Messrs. E. R. Rice, M.P., Pryme, M.P. F. Hodgson, M.P., Ormsby Gore, M.P., G. F. Young, M.P., Emerson Tennent, M.P., Mr. Justice Haggerman, of Canada, Messrs. T. Landseer, F. P. Stephanoff, Belmes, Tomkins, J. Varley, E. H. Bailey, F. Stone, G. Rennie, Fripp, Rivers, Jun., Hakewell, R. Scanlan, Sargey, A. Cunningham, Oliver, Page, S. Howell, W. Boxall, C. Landseer, Macready, Barry, Sydney Smirke, Tite, Donaldson, Hopper, and Poynter.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Monday, May 3.

The annual general meeting of the Institute was held for the purpose of electing the council and officers for the ensuing year. Earl de Grey in the chair.

The report of the council and the annual balance were presented, and exhibited a highly favourable view of the progress of the Society.

Monday, May 17.

A paper was read by Mr. G. F. Richardson, of the British Museum, on the subject of geology as connected with architecture. After a prefatory sketch of the general stratification of rocks, Mr. Richardson adverted more especially to the stratum and quality of those in most general use as building materials. The lecture was illustrated by the exhibition of various objects connected with the subject in the oxy-hydrogen microscope.

Messrs. Pontifex and Co. exhibited a new construction of a self-acting water closet.

ROME AT THE SURREY ZOOLOGICAL GARDENS.

The mimic volcanic flames of Hecla, Etna, and Vesuvius, are now extinct at the Surrey Zoological Gardens, and we have another giant wonder from the burning climes of the South. When we heard that Rome was to be portrayed to the gaze of the successor of its greatness, we were naturally anxious to ascertain whether it had a fitting representative; Mr. Cross has succeeded very well in housing lions and tigers and elephants, but where he was to pitch down the Eternal City we could not readily conceive. He has, however, by placing it near the lake found means to appropriate to it a space of five acres, a space large enough to hold a modern town, and to do justice to the object of this representation. We have here a pictorial model, covering a surface of more than a quarter of a million of square feet, and presenting, as has been well stated, "a stupendous panoramic view, and the largest picture or model ever produced." The lake now stands for the Tiber, and across it we have the bridge of St. Angelo, with its statues of angels on the walls. Beyond are seen on the left the Tordinona Theatre, the Palazzo Tortonia, and other well known edifices. On the right the Mole of Hadrian, now the Castle of St. Angelo, raising its giant bulk. Farther behind, rising over every thing, is St. Peter's, upwards of a hundred feet in height, and appearing as magnificently as its great original. The façades of the Vatican, the Papal Palace, the Ospitale di Spirito Santo, and many other structures well known to fame are strikingly represented. To be properly appreciated this exhibition must be seen; the apparent solidity and verisimility of the structures, the extreme range of distant view, are features which tend to impress us with a sense of the reality of the objects before us. The painting is good, free from glare and exaggeration, and subdued so as to give that sobriety and real life, which augments the impression on the spectator; we think however that the effect might have been increased by a few figures of men and animals being appropriately introduced. The artist is Mr. Danson, and in naming him we do quite enough to show that full justice has been done to the subject, for his reputation in this department of art is a guarantee of the extent of his exertions. We may indeed assure our friends that those among them well acquainted with the Eternal City will be gratified in renewing their recollections of it, and those who have the pilgrimage yet to make, cannot have a better introduction than by a visit to this, its prototype.

NEW INVENTIONS AND IMPROVEMENTS.

IMPROVEMENTS IN STEAM ENGINES.

George Henry Fourdrinier and Edward Newman Fourdrinier, of Hanley, Stafford, paper makers, for certain improvements in steam engines for actuating machinery, and in apparatus for propelling ships and other vessels on water.—Rolls Chapel Office, March 17, 1841.—These improvements are, as the title explains, divided into two parts; the improvements in steam engines consist in applying and working two pistons in one cylinder, which are simultaneously actuated by the expansive force of the same volume of steam. A long cylinder is supported vertically on pivots, in the middle of which it vibrates; two pistons are attached to piston rods which pass out through stuffing boxes at either end of the cylinder. On steam being admitted through suitable slide valves to the middle of the cylinder, the two pistons are forced apart towards the opposite ends of the cylinder, the valves are then shifted, and the steam admitted at the two ends of the cylinder, which drives the piston back again to the centre, the spent steam passing off to a condenser or into the atmosphere, and so on continually. The lower piston rod is attached to a crank in the middle of the shaft, while the upper piston rod carries a cross head from which connecting rods pass down to two cranks placed on the same shaft, but opposite to the former, so that as the one is descending the other is ascending, in conformity with the opposite motion of the pistons. In another arrangement, the cylinder is divided into two parts by a partition in the middle, and the pistons do not expand simultaneously as in the former case, but the one piston begins to move when the other is at the quarter stroke, the valves being so adjusted as to effect this movement; for the purpose of overcoming the dead points, when one piston is at the dead point the other is exerting its full force. The apparatus for propelling ships and other vessels consists of certain arrangements of mechanism by which a volume of air may be forced against the water at the bottom of the vessel, in the direction of its stern, for the purpose of impelling the vessel in an opposite direction. The air being compressed by an air pump, "to the same density as the water under the ship's bottom," is admitted through a valve into a tube, down which it flows into the water. The bottom of the vessel has two guards of wood or other material, parallel to its keel; as the air enters the water beneath the vessel it is guided by the guards, which prevent it from escaping at the sides, and by its pressure against the water, in the direction of the stern, impels the vessel head foremost. The direction of the air, backward or forward, is regulated by a tumbling valve, worked by a quadrant rack or sector, and an endless screw; by altering the position of this valve the direction of the air, and, consequently of the vessel, may be reversed at pleasure. When the vessel rolls about in a heavy sea, it is considered desirable to force the air under the most depressed side of the vessel only; to effect which the air plugs are connected to a pendulum which opens the valves on the one side or the other, according to the position of the vessel. In another arrangement for reversing the motion of the vessel, two sets of sliding tubes descend from the air chambers, opening fore and aft; if the vessel is to be propelled head first, the two hinder tubes are depressed and the air passes off towards the stern; but if the vessel is to be backed astern, the foremost tubes are depressed and the air projected towards the head of the vessel. The claim is—1. To the application of two pistons working in one cylinder, as shown.—2. For propelling vessels, by forcing a volume of air against the water beneath the bottom of the vessel, in the manner shown and described.—*Mechanics' Magazine.*

MOVEABLE OBSERVATORY AND SCAFFOLD.

Alexander Horatio Simpson, of New Palace-yard, Westminster, Middlesex, gentleman, for a machine or apparatus to be used as a moveable observatory or telegraph, and as a moveable platform in erecting, repairing, painting, or cleaning the interior or exterior of buildings, and also as a fire escape. Enrolled May 5.—Claim first. The use of a shaft or spar as herein described, with a gallery or platform suspended or attached so as to be capable of being raised or lowered on the shaft by a power, either manual or otherwise, exerted within the platform.

This machine consists of a shaft or spar, mounted in a step, in which it is capable of turning (the step being fixed to a foot or pediment), and supported laterally by stays, jointed at their upper ends to a collar, which slides on the shaft, but is retained in any required position by a pin. The lower ends of the stays fit into holes in the foot or pediment, so as to admit of the stays altering their position or angle, in relation to the shaft, and thereby supporting it in different positions. The shaft is constructed of wrought iron plates, rivetted together, and one side of it is formed by a rack sunk flush with the surface of the shaft, which rack may be of cast iron; but one of the lantern form is preferable, the teeth of which is formed by long bolts or rivets, running across in the same position as the teeth of the cast iron rack. On the shaft is a sliding frame, to which is attached a gallery for the reception of workmen, tools, &c., and this sliding frame is fitted with a pinion, whch working in the rack of the shaft raises or lowers the gallery or platform, according to the direction in which it is turned.

This machine may be used as a telegraph, by having the usual apparatus attached to the top of the shaft, or it may be used as a moveable observatory.

Claim second.—The use of a horizontal suspension rail, supported by shafts or spars, with a platform or gallery suspended therefrom, capable of receiving motion from within the gallery.

Claim third.—The giving motion to the gallery or platform, by the application of a power, either manual or otherwise, from a point not within the gallery or platform.

This part of the invention is an improved construction of scaffolding, and consists of two shafts, placed one on each side of the front of the building, similar to that before described, but without the rack and platform with its appendages. On the top of these shafts is fitted a cross rail, on which is mounted a carriage running on flanged wheels, and to these wheels are fixed two "gallows," suspending a light ladder by a pin or bolt. On the centre of this bolt is a roller or pulley, over which a rope passes, one end of it being fastened to a gallery similar to that before mentioned, and sliding on the ladder, and the other end to a counterpoise weight. On the foot of the ladder there is another roller, that runs on a cross bar, similar to the bar at the top, but which roller supports none of the weight of the ladder, as it rolls nearly horizontally and against the side of the bar, being provided for the purpose of permitting the ladder to travel easily to and fro.

In order to bring the gallery to bear on any portion of the surface of the building that the workman may require, four ropes are provided; two of these are fastened to the bottom of the shafts, and passing over two live pulleys at the foot of the ladder, proceed up to the gallery; the other two are fastened to the top of the shafts, and pass over two live pulleys, on the same axletrees as the wheels of the carriage before mentioned, into the gallery.

Now if the person in the gallery pulls the two top ropes, he raises the gallery, or if he pulls the two bottom ropes, he lowers it; if he pulls either of the two side ropes, namely, those attached to the same shaft, leaving the other two side ropes loose, the gallery and ladder will move horizontally in a lateral direction.—*Ibid.*

DRIVING BELTS AND STRAPS.

James Heywood Whitehead, of the Royal George Mills, near Saddleworth, Yorkshire, manufacturer, for improvements in the manufacture of woollen belts, bands, and driving straps. Enrolled May 2.—This invention consists in applying a composition to a woollen belt to give it firmness and adhesiveness, as a substitute for leather for driving machinery.

The composition consists of linseed oil and resin mixed together, in the proportion of three pounds of linseed oil to two pounds of resin; but these proportions may be varied a little to suit circumstances. The oil is first boiled, and the resin in fine powder added to it while it is in the boiling state, being well stirred till they are thoroughly mixed together.

The belt or strap is passed through the mixture and between two rollers, which are weighted sufficiently to make the composition even, so that it will not run out of the cloth when hung up. The cloth is then well stretched in length and dried, after which it is ready for use.—*Inventors' Advocate.*

RAILWAY CARRIAGE.

James Boydell, jun., of Cheltenham, ironmaster, for improvements in working railway and other carriages, in order to stop them, and also to prevent their running off the rails. Enrolled May 2.—Claim first. The mode of applying apparatus acting by lever pressure on rails, as a means of stopping carriages, as herein described.

Beneath the lower part of the railway carriages a projection is affixed, carrying the axis of a lever, the lower end of which lever is enlarged and embraces the rail, the part which comes against the rail being lined with wood, to enable it to offer greater friction. This part of the lever is, by means of another lever, and connecting links, brought in contact with the rail, whenever it is desired to stop the train.

Claim second.—The mode of applying bars to prevent carriages running off the rails of railways.

Beneath each carriage are two bars, which extend across from opposite corners of the framing of the same, crossing each other beneath the centre of the framing, and from which centre they are suspended by means of a pin passing through a slot formed in the centre of each bar. The ends of the bars are connected by pins to the ends of the bars of the carriages before and behind them, thus forming a continuous bar, which will in most cases prevent the carriages from getting off the rails, and in case one of the carriages should run off the rails will prevent it from running at any considerable angle to the same. The slots in the bars have sufficient play to permit the train to move over curves easily.—*Ibid.*

MR. GRANT'S PATENT FUEL FOR STEAM BOATS.

We learn with great satisfaction, that this important invention is at last to be brought into general use. The Admiralty, after a long series of experiments made under their directions, by Mr. Grant, and followed up by frequent trials of his fuel in her Majesty's steam vessels, instructed him some time ago to take out a patent, chiefly, we suppose, to secure themselves and the public against the interference of any pretenders to the invention.—This point being settled, it became the wish, as it was the obvious duty of government, to extend the benefits of Mr. Grant's labours to the country at large.

Numerous applications having been made to Mr. Grant, by the various steam vessel companies, for permission to make use of his patent, the Admiralty, in a spirit of enlarged policy, have, as we understand, directed that gentleman to refer all persons to them who desire licenses to manufacture his fuel—and we have no doubt that their Lordships sanction will be given accordingly. But, we trust, the terms will be so moderate as to render it the interest of those extensive companies, whose vessels now cover so many seas, to employ this new agent for the production of their steam power.

A word or two on the nature and properties, as well as the practical advantages of Mr. Grant's fuel, will probably not be unacceptable to our readers generally, and may prove useful to such persons as are engaged in steam boat enterprises on the large scale.

It is not our purpose, nor would it be proper, to describe minutely Mr. Grant's process—it will be enough to say, that his fuel is made of coal-dust and other ingredients, mixed together, in certain definite proportions, and then fashioned, by a peculiar process, into the shape and size of common bricks. The advantages of Mr. Grant's patent fuel over even the best coal may be stated to consist—first, in its superior efficacy in generating steam, which may be stated in this way—200 tons of this fuel, will perform the same work as 300 tons of coal, such as is generally used;—secondly, it occupies less space, that is to say, 500 tons of it may be stowed in an area which will contain only 400 tons of coal;—thirdly, it is used with much greater ease by the stokers or firemen than coal is, and it creates little or no dirt, and no dust—considerations of some importance when the delicate machinery of a steam engine is considered;—fourthly, it produces a very small proportion of clinkers, and thus is far less liable to choke and destroy the furnace bars and boilers, than coal is;—fifthly, the ignition is so complete, that comparatively little smoke, and only a small quantity of ashes are produced by it;—sixthly, the cost of the quantity of Mr. Grant's fuel required to generate in a given time a given amount of steam, is so much less than that of the quantity of coal which would be consumed in effecting the same purpose, that, even if the advantages of stowage, cleanliness, and facility of handling, were not to be taken into the account, the patent fuel would still recommend itself to the attention of all steam boat proprietors.—*Hampshire Telegraph.*

[The first part of this statement appears to us rather extraordinary that the Lords of the Admiralty should interfere with the working of a patent in any kind of way, and that parties requiring licenses are to be referred to them; surely there must be some mistake in the statement.—Editor C. E. and A. Journal.]

APPLICATION OF ELECTRO-MAGNETISM TO MACHINERY.

(From the Leipsic Allgemeine Zeitung.)

Leipsic, April 17.

The meeting of our Polytechnic Society was rendered peculiarly interesting by a lecture given by Herr Störer on his experiments in the application of electro-magnetism as a motive power. Herr Storer commenced his experiments several years ago, before Wagner's invention, and has proceeded independent of it. By merely following up and carrying out the ideas of Jacobi, to whom the first merit of the discovery is due, he has succeeded in constructing a small machine, the power of which is as yet limited to the raising of only a moderate weight and putting a turning lathe in motion, but which is nevertheless sufficient to render perfectly evident the whole mechanism of the important invention, and which, as the constructor observed, needs only to be enlarged to produce more practical effects.

The principle of electro-galvanic movement has its source, as is well known in the law of reciprocal attraction and repulsion of two iron bars, surrounded by a galvanic current, alternating with positive and negative electricity, and thereby magnetized. Herr Störer's machine consists at present of only two concentric circles of spiral iron bars, surrounded by conducting wires for the reception of the electric current. Each circle contains 12 single bars, placed at the distance of from 2½ to 3 inches from each other, the bars of the outer circle being about half an inch separated from those of the inner. The outer circle is fixed; the inner forms the periphery of a moveable disc, swinging wheel, or pinion. This mechanism is brought into connexion by two conducting wires with a galvanic battery, in such a manner that in the first place the bars of the one circle with positive electricity surround those of the other with negative electricity; then suddenly, by an arrangement in the conducting apparatus, the current is changed, and thereby electricity of the like name is produced in both circles. The consequence of this is, that the opposite bars, in consequence of the different magnetic power communicated to them, first attract each other, then instantly becoming, by the inversion of their poles, similar magnets with equal force, repel each other. By this regularly repeated alternation of attraction and repulsion, each bar of the internal moveable circle is in succession drawn towards all the bars of the external fixed circle, and then driven as it were back on the next, whereby the whole disc is brought into a state of uniform motion.

The inventor makes a very moderate estimate of the cost of the machine. The expense consists chiefly in the wear of the zinc in the galvanic battery, by the action of the acid; but as to the outlay for this article, it will be almost entirely counterbalanced by the precipitate which in consequence of the operation is formed in the acid, and which yields a somewhat valuable chemical product. With regard to the power of the machine, and the possibility of reinforcing it so as to produce greater practical effects, Herr Störer submits the following considerations:—The present machine, though only double the size of the one he first constructed, which had only six pair of bars, acts with a sixfold increase of force. Each galvanic element consists of a copper cylinder, a zinc cylinder within it, and a chemical mixture by which they are connected. Now, as respects the effect of the number of elements employed, Herr Störer makes the following observations, the accuracy of which he has proved by experiments:—"In the connexion with a single element the machine raises, with moderate velocity, 3 lb.; with two elements, 13 lb.; with three, 25 lb.; with four, 40 lb. This is approximatively an ascending gradation of power in the ratio of 1, 4, 8, 12, whence it certainly would appear that the force might not be found to augment exactly in the relation of a progressive increase of the elements." According to Herr Störer's calculations, the connexion of a battery of 50 elements, with a machine in cubical contents 26 times greater than the one exhibited, would produce an effect equivalent to 50 horse power.

Still, however, after all these data and calculations, there remain several doubts as to the practicability of the application of this invention to machinery on an extensive scale. On the other hand, the results obtained by the experiments hitherto made are of sufficient importance to encourage a spirited prosecution of the discovery, which is in itself so ingenious, that it ought to be joyfully hailed by all who take an interest in the progress of civilization, as a new triumph of the human mind over inanimate matter. At all events, we Germans have just reason to be proud of an invention the first idea of which came from a German, and all the improvements yet made in which are the offspring of German intellect and German perseverance.

CONTINENTAL MODE OF BORING, BY APPLICATION OF THE ROPE.

When I was lately residing on the Continent, I occasionally observed notices in the foreign papers of this mode of boring, with flattering accounts of its advantages. I was anxious to obtain information about it, but I did not succeed in doing so until I perused the official report of M. Jobard on the Paris exhibition of 1840. His account is, indeed, in some degree, defective, as it does not furnish diagrams of the instruments; nevertheless, it gives a general view of the method, which seems to be attended with the surprising benefit, that the expense of the bore per fathom does not increase in any considerable degree with the depth of the bore. Having both observed and experienced the cost, danger, and tardiness of the bore with boring rods, when a great depth is reached, I have found M. Jobard's report interesting and instructive; and, therefore, as the subject may be new to some of your readers, I venture to send you the substance of it, in case you think it worth insertion in your valuable Journal.

There are in all three instruments, or tools, used in the method alluded to—the *mouton, emporte pièce*, and *alèzoir*. The *mouton* is a cylinder of cast-iron, of about eight inches in diameter and thirty-nine inches in height—weight from one to three cwt. This cylinder has exterior flutings, 1-10ths of an inch in depth and 6-5ths of an inch in breadth; the upper part contains an empty cone, whose base is reversed, which gives it the form of a bucket with thick sides. There are two handles to the cylinder, one above the other—if the first should break, the second retains the rope. The lower part of the tool is prepared to receive a number of steel chisels, which are fixed by a transversal key. The tool should be composed of as few pieces as possible, for, however well they are fixed, the percussion tends to detach them, and to leave them at the bottom of the hole. The best way of procuring good moutons of percussion, for hard strata, is to make them all of one piece of case-hardened cast iron, with handles of malleable iron hooked into the cast iron. These handles should be high up, in order to facilitate the extraction of the powdered stone, which accumulates in the empty part of the mouton. The head, or top, of the tool should exhibit a number of pyramidal points, projecting about an inch, diamond-pointed, the better to cut into the stone. The case-hardening gives them the hardness of tempered steel, and makes them last a long time. A mouton of three cwt. costs only 50f. (2*l.*); when it is worn, the old metal serves for the casting of others. The rock is cut daily to the depth of at least 39 inches. The rope is worked by a long plank placed obliquely, the upper end being about 12 or 15 feet above the hole. The mouton is suspended about 15 or 20 inches from the bottom of the hole. Motion is given to this plank by the hands or the feet, or by several men pulling together by ropes attached to the plank. There are also several other ways of working the main rope.

In boring with boring rods, four or five hours are required to draw them and lower them again; but all this is done (when the bore by means of the rope is used) in eight or ten minutes. In this latter, then, the progress of the work is always nearly the same—at 3000 as at 100 feet. The same number of men, too, is sufficient to work it, let the depth be what it may. What takes place, is as follows.—The mouton, falling 25 or 30 times a minute, from a height of two or three feet, readily breaks and pounds the rock. The dust or powder which results from this would soon deaden the blow, if there were no water in the bore hole, but there is almost always some—if not, it should be thrown in. The water and the dust form a magma—a mortar or mud, which spouts up by the flutings carved around the mouton. This mud falls back necessarily on the head of the mouton, and, as this is hollow, the mud enters a little at every blow. This powdered stone heaps up in the interior of the cone, by the work, to such a degree, that force is often necessary to get out the stony sugar-loaf which is there concreted after some hours striking. The contents of the instrument are known; it is sufficient, then, to put a mark on the rope, at such a height, to know that, when the rope has lowered a certain distance, a certain number of inches of matter have passed from below to above the tool. Before retiring the mouton it should be left at rest one or two minutes, to allow the heavier particles of the mud, which are in suspension at the bottom of the bore hole, to deposit themselves on the bucket—but not longer, for so it might get it incrusted.

The mouton alone suffices to the Chinese to bore to the depth of 1800 feet. Their strata are hard and solid enough not to require tubing, but it would not do for clay, sand, or pebbles—in that case the *emporte pièce* is requisite. It is a cylinder, which has at its base two valves, turning on a hinge in the diameter, in the form of the wings of a butterfly. This cylinder is lowered to the bottom of the hole, and is caused to penetrate the strata by the intermediate percussion of a mouton, of the weight of 65 lbs., which is made on purpose for the emporte pièce. The mouton, having an aperture in the centre, slides for some feet along a metallic rod, which is fixed to the emporte pièce. When the mouton is raised, it gets as far as a bolt, which stops it; it then falls on the emporte pièce, which latter sinks at every blow, and its valves open to let the mud pass. When it is thought the instrument has sunk far enough, it is drawn up, and it arrives with a cake of mud, &c.; but care should be taken not to allow it to sink too far into plastic clay—it might then be difficult to draw it out. For strata which require tubing, there is, besides, the *alèzoir*. The following is the simple artifice employed to enlarge the bore hole when it is tubed (or, to resolve the problem, to form with an instrument, which is obliged to pass through a tube, a hole larger than the exterior of this tube):—The tube is supported by straps, at about two lengths of the mouton from the bottom of the hole. The mouton used in this case has a square, and not a round, handle at its upper part. It is easily conceived that, if the rope is fastened to the middle point of the handle, which corresponds to the centre of gravity and to the centre of figure, the mouton would strike straight, and would only form a hole equal to the diameter of the instrument or the interior diameter of the tube; but if the point to which the rope is fastened is borne away one or two inches from the middle point of the handle, the centre of gravity becomes displaced, and the lower part of the mouton inclines to the right or left—a position which causes it to rob and wear away the sides of the hole with its crown, at the same time that it attacks the bottom with its steel teeth. When this instrument, which is slightly conical, is drawn up, it sets itself straight again, and rises up in the tube, exercising a feeble friction on the sides of the tube. This mouton, like that for the strata, which require no tubing, has a receptacle for the mud. In using either mouton, a movement of torsion must be impressed on the rope. This is effected by fixing the rope into the extremity of a wooden bar, of about two feet long, which gives a workman sufficient leverage to turn or twist the cord a little at every blow, or to regulate its untwisting. In this way the hole cannot fail to be circular and quite perpendicular. By this means, at the well of the Military School, they have got down a single tube of iron plates, rivetted, of 11 inches diameter, to the depth of 650 feet. The tube moves freely—one man can turn it round. The wire rope would answer well for this mode of boring. The moutons are not difficult to make; a village blacksmith may construct or repair them; he should fasten the steel chisels in such a way that they can be occasionally taken out to be sharpened. The method of boring by means of the rope is much used in Saxony.—*Mining Journal.*

BUILDERS' BENEVOLENT INSTITUTION.

In another part of the Journal, it will be seen that we have requested the attention of our engineering readers to the merits of an institution for the relief of engineering workmen, and now we have to make a similar request of our architectural readers. They will see that a meeting has been held for the purpose of establishing a Builder's Benevolent Institution, and we hope that they will readily lend their aid for the promotion of an object so laudable. We need scarcely say that it has our very best wishes for its success. The meeting to establish an asylum and pension fund, and for the general relief of the decayed and suffering members of the builders' trade, was held on the 24th ult. at the Crown and Anchor, Strand; Mr. Burnard, surveyor, in the chair. The advertisement convening the meeting having been read by Mr. Barber, the secretary, the chairman, in a brief but neat speech, detailed the objects of the institution, remarking that there were no less than 20 trades connected with the building business—as architects, surveyors, painters, engineers, bricklayers, slaters, sawyers, &c.; yet the builders had neither an institution like that which they were assembled to establish, nor an asylum, nor any benefit society to apply to in poverty or old age. The objects for which the institution was about to be formed were highly praiseworthy and beneficial, and he was glad to say, that the committee had been promised support in all cases in which they had applied, and he hoped soon to see the builder's asylum rise second to none even in this great metropolis. The secretary then read letters from the Marquis of Westminster, the Earl of Cadogan, Sir R. Peel, Mr. Barry, the architect, Mr. Philip Hardwicke, Mr. D. Burton, Mr. Thomas Cubitt, Alderman John Johnson, and many other gentlemen of standing and respectability, all concurring in the objects of the meeting. The report of the committee was then read. It contained a well-written narrative of the steps the committee had taken, the reception they had met with from those to whom applications had been made to assist them in their praiseworthy endeavours to found the Builders' Asylum, and concluded with a very flattering account of the success that had attended their efforts. The report being adopted, a series of resolutions was put and passed in the usual manner. A subscription was entered into before the members left the room, for carrying out the purposes of the institution, and was liberally responded to.

REPAIRING AND MAINTAINING OF PUBLIC WORKS.

The following important judgment in the case of *The Queen* v. *The Bristol Dock Company*, was delivered in the Court of Queen's Bench, Westminster May 25, at the sittings *in Banco*. The defendants in this case have been incorporated under the 43rd George III., c. 140, for the purpose of making, completing, and maintaining a new watercourse in connexion with the river Avon, and this purpose they had effected. Some part of the works of the new watercourse, however, became subsequently out of repair; and upon a former occasion a rule had been obtained calling upon them to show cause why a *mandamus* should not issue commanding them to repair that portion of the banks of the new watercourse which had become dilapidated, and which, in its present condition, caused an obstruction to the navigation. The rule was made absolute, and the writ having issued, the defendants returned that they were not bound, according to the general law of the land, or to the provisions of the particular act above mentioned, to repair the portions of the watercourse which formed the subject of the discussion.

Lord Denman now delivered the judgment of the court upon the case, which was, that in the circumstances of the transaction the defendants were bound to make the repairs which the writ commanded them to make. His lordship laid it down in the course of the judgment, that where parties obtained an act of parliament for the construction and maintenance of great public works, they were bound in law to fulfil all the incidental duties of which the performance was necessary for the discharge of their duties in respect to the principal subject. His lordship also stated, that if public bodies omitted the performance of such incidental duties, they would be compelled to do so by the direct interposition of this court. It had been argued upon the part of the defendants, that as the injury consequent upon their neglect to repair the bank was of a public nature, and one for which they were liable to an indictment, that particular proceeding ought to be adopted, and there was therefore no necessity and no ground for a *mandamus*. The court, however, dissented from this position, and declared that where a company were obliged to do a particular work, and where the consequence of their not doing it was to produce a public nuisance, that circumstance, although it rendered them liable to an indictment, did not release them from the necessity of a specific performance of their duty upon the subject, in obedience to the mandate of this court. In this case, therefore, a peremptory *mandamus* would be awarded.

S. L. IN REPLY TO CANDIDUS.

Sir—I am surprised that Candidus should have thought it necessary to combat an imaginary assertion by such very trite observations. But he is evidently affected with the usual mania of critics, viz., that of putting an arbitrary interpretation on the object of their criticism, and then attacking the author for entertaining an idea which is but the fruit of their own fertile imagination. For instance, where Candidus can find that I have said any thing to discourage the roughest handling of public men, if kept within the bounds of truth and reason, I cannot possibly conceive; nor can I find any thing which can justify his supposition, that I may probably greatly prefer Buckingham Palace to Windsor Castle, &c.

With regard to mullioned windows, I confess I cannot see the propriety of substituting any thing which would have the effect of an open screen, for a glazed window; and though we may make infinitely greater departure from the genius of Grecian architecture. Candidus may remember that pure Grecian was not the style advocated; the architect must go to Rome and Pompeii for his materials, as well as to Athens.

When I spoke of the difficulty of persuading persons to adopt Gothic, who are not possessed of antiquarian taste, I said nothing about "soi-disant" or "hole-in-the-wall" Gothic; every one is aware of the great facility afforded for the adoption of that style—I mean by Gothic such as would do credit to an architect; but most persons find this to interfere too much with their comfort for them to "allow it to be properly treated."

With respect to what Candidus is pleased to call my very bold assertion, I would beg him to observe that I stated that the *object* of the architect, when he employed the Grecian or Roman style, was invention, not that originality was always the *result* of his efforts. I shall, however, be glad if he will refer me to a modern Gothic building possessing half as much originality as St. Stephens, Walbrook, or the spire of Bow church.

I quite agree with Candidus that it is well to avoid "squeamishness and affected delicacy in architectural criticism," but it would also be well if he would pay some respect to decency in the choice of his expressions, and not make use of those of which a gentleman would be ashamed, and which diminish, rather than increase, the force of his observations.

I remain, &c.,

S. L.

STEAM NAVIGATION.

THE MONGIBELLO STEAM SHIP.

This fine vessel belonging to the Neapolitan Steam Navigation Company at Naples, is fitted with a pair of Messrs. Maudslay, Sons and Field's patent double cylinder engines, of the nominal power of 200 horses; their general principle is described in the last volume of the Journal, page 73.

The improvements realized in this description of engine are *first*, that the power is applied more directly to the cranks than in any other construction, having only two working joints through which the power is conveyed, viz. the lower and upper ends of the connecting rod, the stroke being of the usual length, and the connecting rod of the usual proportions; the force of the engine is also so completely confined within its own framing, that no strain is thrown upon the vessel. The *second* advantage is that the space occupied by the engine, is not greater than in an engine of half the power, on the side beam construction, and when combined with their improved boilers, (as is the case on board the Mongibello), the total length occupied by the machinery is reduced to 40 feet, whereas the ordinary construction requires 60 feet, thus effecting a saving of one-third, on this most important head. The *third* advantage arises from the reduction in weight, which in the Mongibello, and including water in the boilers, was 150 tons, being 13½ cwt. per horse power, instead of one ton per horse power, which is the weight in beam engines, and even this is often much exceeded.

These advantages, which bear so strictly upon the profitable employment of steam vessels, are fully realized in the one in question, which is of 509 tons burthen, being 156 feet long, and 26 feet beam; besides the saving in space referred to above, the machinery of the Mongibello is about 70 tons lighter than ordinary beam engines, and in addition to the increased tonnage derived from the saving in space. She thus possesses 70 tons additional buoyancy for cargo, or coal, for a more extended voyage. Another consideration, which ought not to be overlooked, is that in building a vessel to carry a certain number of passengers, or quantity of cargo, the first cost of the vessel may be much reduced; the same space for passengers and tonnage for goods, may be obtained by a vessel of 70 tons less measurement, and the saving under this head cannot be estimated at less than 1400*l.* in a vessel of the size of the Mongibello, and it would be greater as the size increased.

These engines work with great steadiness and effect, making 25 strokes per minute, and performing from $11\frac{1}{2}$ to 12 miles per hour. They are fitted with expansion gear, brine pumps, &c. In short the vessel is replete with every requisite for a sea-going ship.

RENNIE'S TRAPEZIUM PADDLE WHEEL.

In our number for March last, we enumerated some of the advantages which were likely to be derived from the adoption of the above invention in steam navigation; we have now the satisfaction to lay before our readers the results of a series of experiments which have been made on the efficacy of the Trapezium Paddle Wheels in comparison with the common Rectangular Paddle Wheels. The Lords of the Admiralty having decided that the trial should be made upon a vessel of known qualities, fixed upon the African, an old gun brig which had been converted into a steamer, by two engines of 45 horse power put into her, as best calculated to give a comparative result. Accordingly the old paddles were removed, and a pair of trapezium wheels fixed in on the same shaft, which formerly served for the old wheels, so that with the exception of a slight alteration in the paddle boxes, no further additions were required. On the 14th of April last the whole being ready, the engines were set to work, and the vessel proceeded down the river to the measured mile in Long Reach.

The dimensions of the African are—length, 109 ft. 10 in. midship section; breadth, 24 ft. 10 in. semi-elliptical, bluff at the bows; depth, 12 feet full at the quarters. She is a good sea boat, but not calculated for high velocities, as compared with steam vessels of modern times.

The power of the engines is two of 45 horse power each, the number of strokes 29 to 30.

The velocity of the vessel at a load draught of 9 ft. 5 in. is nine miles per hour through still water

According to a series of experiments made with the African by Mr. Kingston, Admiralty engineer, the diameter of the old wheel was 14 ft. 7 in., the width 7 feet, the area of the floats immersed was about 62 feet super., the mean draught of the vessel was 9 ft. $4\frac{1}{2}$ in., and with the barometer at $26\frac{3}{4}$ inches, and the engines making from 29 to 30 strokes per minute, the maximum mean velocity opposite the measured mile was 9·174 miles per hour.

	miles per hour.
On the 14th of April last, the engines making from 22 to $23\frac{1}{2}$ strokes	8·29 to 8·75
On the 26th April, 23 strokes	8·4 to 8·6
On the 1st of May, 25 to $28\frac{1}{2}$ strokes	8·8 to 9·032
On the 8th of May, 25 strokes	8·6 to 8·8
On the 12th of May, 26 to $27\frac{1}{2}$	8·5 to 9·136

The last results were obtained with from $2\frac{1}{2}$ strokes of the engines less than formerly, and with a reduced diameter of wheel of 22 inches, and an immersed surface of 30 square feet. The action of the float in the water was entirely free from shocks or vibration; thus establishing on a greater scale than hitherto, the properties of the trapezium wheel as promulgated in the prospectus, namely, that it combines all the advantages of the common paddle wheel, and does away with all its defects, arising as before stated, from the great weight, width, and indirect action of the former, and combining all and even greater simplicity of the latter.

The Steam Frigate "Styx"—On the 6th of May an experimental trip was made with this vessel down the river as far as Gravesend. There was present a numerous party of naval and scientific gentlemen, among whom were Lord Prudhoe, Admiral Sir Philip Durham, Sir W. Symonds, Chevalier Benkhausen, the Russian Consul General, Mr. Routh, &c. She is what is termed a second class government steam frigate, and the third vessel of that class fitted within the last six months. Altogether there will be five vessels, viz., The "Driver," "Vixen," "Styx," "Growler," and "Geiser," the two latter are not yet finished; they are all built to one mould, under the direction of Sir William Symonds, and to be fitted with engines by Messrs. J. & S. Seaward & Capel. The dimensions of the "Styx" are, length 210 feet over all, or 185 feet between perpendiculars, 36 feet breadth of beam, and 21 feet depth of hold; she draws 13 feet aft and 12 feet forward, and when laden with her full complement of guns, stores, &c., 15 feet aft and 14 ft. 6 in. forward. She is to carry four 8 inch guns, for 64 lb. hollow shot, and two 10 inch guns on swivels and slide beds for 96 lb. hollow shot. The two engines are of the collective power of 560 horse power; the cylinders are 62 inches diameter, and 5 ft. 3 in. stroke, performing 17 strokes per minute; the paddle-wheel is 26 feet external diameter, breadth of float boards 8 ft 3 in, divided into two, each being 11 inches wide. The engines are upon Messrs. Seaward's patent principle, the action being applied direct from the piston rod to the crank of the paddle shaft, as adopted on board the "Cyclops." Drawings and a description of these engines will be found in the Journal for February last. Mr. Samuel Seaward has also applied his patent for disconnecting the paddle wheels, which is extremely simple and efficacious; it only required 3 minutes to disconnect one of the wheels, and 4 minutes to reconnect it, and we have no doubt if the men had had a little more experience, they could have been connected and disconnected in half that time. The engines worked very beautifully, and free from the slightest vibration; the speed through still water was at the rate of about $10\frac{1}{2}$ miles per hour. During the excursion the company were entertained with a sumptuous collation.

Blackwall Steamers.—The Blackwall Railway Company have had three iron steamers built by Messrs. Ditchburn and Mair, to run from the Brunswick Pier to Gravesend, viz. the "Brunswick," "Railway," and "Blackwall," all of one mould. Their length is 146 feet and 19 ft. beam. The mould is beautiful, the bows being remarkably sharp, and throwing but little, if any, wave in front; the cabins are tastefully finished, and do credit to the builders. Each vessel is fitted with engines of 90 horse power collectively, and all have tubular boilers. The *Brunswick* has a pair of oscillating engines by Messrs. J. & S. Seaward & Capel, and the same description of engines are on board the *Railway* fitted by Messrs. John Penn & Son. We were present at an experimental trip of this boat on Saturday the 8th ult., when her speed exceeded that of any other boat on the river; indeed her average is about 16 miles per hour. Her performance gave great satisfaction to the Directors of the Railway who were on board, and to the company generally. The whole of the machinery including the boilers is only $45\frac{3}{4}$ tons in weight, very little more than one half the usual weight of engines of so large a power. The other vessel, the "*Blackwall,*" has a single steeple engine of 90 horse power fitted with tubular boilers by Messrs. Miller, Ravenhill & Co. We understand that the speed of this vessel is nearly equal to that of the "*Railway.*"

The Elberfelt.—This splendid vessel built of iron by Messrs. Ditchburn and Mair, for navigating the Rhine, performed an experiment trip on the Thames on the 8th instant. Her dimensions are, length 176 feet, beam 21 feet, depth 11 ft. 6 in., and draws only 2 ft. 8 in. of water. her cabins are fitted up with great taste, particularly the ladies cabin, and the saloon which is decorated with views on the Thames,—throughout the vessel every attention has been paid to the comforts of the traveller. She is propelled by a pair of oscillating engines of 55 horse power each, by Messrs. Miller, Ravenhill and Co., her speed in still water is calculated at 13 miles per hour; the boilers are tubular, of Mr. Spiller's patent.

Steam Frigates.—The town of Greenock exhibits at present a scene of no common interest. Six large steam frigates are now being constructed in the town or its vicinity, each of these of about 1,500 tons capacity, and carrying engines of 500 horse power, being part of the fleet of 14 armed frigates destined in time of peace to carry out and distribute the mails among our West Indian colonies. Four of these are to be supplied by a single firm in Greenock, who deliver the ships, engines, and equipments complete, and ready for sea. We announced a short time ago the successful launch of the first of these four, the Clyde, which was constructed by the late Mr. Duncan. The second of these ships, the Tweed, was launched from the yard of Messrs. Thompson and Spiers on Saturday last, and we hope soon to announce the completion of the series of these four sister ships, in the launch of the Tay and the Teviot, which are rapidly progressing on the stocks. In general appearance and construction this ship resembles closely her precursor, the Clyde, being slightly fuller forward, and finer abaft. To the eye she also seems larger than the Clyde, but this may arise from the latter being a foot or two deeper in the water, having already her whole engines and boilers fitted up on board, although it is only about two months since her launch. The dimensions of the Tweed are as follow:—Length, over all, 240 feet; keel and forerake, 215; beam, 37; depth, 30.—*Greenock paper.*

Thames Steamers.—The competition among the steamers has become so great, and their numbers have so much increased of late, that 17 vessels are daily engaged in conveying passengers between Gravesend and London. Some of them charge 2*s.* in the after cabin, and 1*s.* 6*d.* in the fore part of the steamer, for each passenger; others 1*s.* 6*d.* and 1*s.*, and a few 1*s.* only all over the vessel; while the steamers from Blackwall to Gravesend convey passengers for 8*d.* each. Fourteen steam vessels are engaged in carrying passengers between London and Greenwich, and a majority of them have lately reduced their fares to 6*d.* each; but the pier dues swallow up one-third of the fare, and it is doubtful whether the steam boat companies will be able to continue the reduced fares for any length of time. Eight steamers are constantly running to and from Woolwich, and they will receive a great accession in a few days by the fast and elegant boats of the Watermens' Steam-packet Company. There are 16 small vessels belonging to different companies steaming away from morn till night above bridge, and on Sunday last they carried upwards of 55,000 passengers, at 4*d.* per head, between the numerous piers from London-bridge to Chelsea.—*Times.*

Improvement in the Construction of Steam Ships.—A Correspondent of the *Times* suggests that safety bulkheads, by which a vessel is divided into three or four water-tight compartments, should be introduced into ocean steamers in future. The suggestion is an excellent one, but it ought to be enforced by legislative authority, and applied to all steamers. Many lives and much valuable property would have been saved if such a regulation had been in force since steam navigation has been so largely extended. The loss of the Phœnix, which was struck before the paddle-box by another large steamer at sea, affords one instance; and the Albion, on her voyage from Dublin to Bristol, touched a sunken rock on the Welch coast, and immediately went down in comparatively smooth water, and on a beautiful day, in consequence of the leak produced in her bow. The distressing loss of the Killarney, on the coast of Cork, would, no doubt, have been averted, had not the fires in the engine-room been extinguished by a leak, which it was impossible to keep down. Many other cases might be cited; and we shall place in juxtaposition with the preceding an accident which happened to the Royal William a celebrated steamer belonging to the City of Dublin Company, on one of her voyages from London to Dublin. This vessel, we must premise, like several others belonging to the same spirited company, is divided into water-tight compartments by bulkheads. One dark stormy night, when off the Isle of Wight, she suddenly came into violent collision with a three-masted ship, which exhibited no lights; and a large hole was made in her bow, which must, had she been built like ordinary steamers, have involved her almost instantly in the same fate as the Albion. The bulkhead, however, near her bow, prevented the leak from spreading—nay, so little inconvenience did this alarming collision occasion, that she proceeded on her voyage to Plymouth, scarcely depressed in the slightest degree, to use nautical language, "by the head." This is a striking anecdote; and we only wonder that steam-boat proprietors have not long ago seen the importance, even for their own interest, of adopting the mode of construction which saved the Royal William. We repeat that that they ought to be compelled to do so; and we trust that some member of Parliament will bring the subject forward without delay. We are not able to say whether some such safeguard might or might not be adopted in ships; but the recent frightful loss of life occasioned by the sinking of the Governor Fenner, owing to a collision with a steamer, ought at all events to draw attention to the subject. In the Thames 1,000 or 1,200 persons often trust themselves in a single steamer of comparatively slight construction.—*Glocestershire Chronicle.*

Launch of a Steam Frigate.—The West India Royal Mail Steam-packet Company's magnificent and powerful steam ship the Forth was launched from the building-yard of Messrs. Robert Menzies and Sons, Leith, on Saturday last. She glided into the Forth, the estuary after which she has been called, in a most majestic manner, and in presence, it is reported, of not fewer than 80,000 spectators. So gay a scene had not been witnessed in Leith since the visit of his late Majesty George IV., in August, 1822. The following are the dimensions of the Forth:—Length of keel, 215 feet; on the spar deck, 229 feet; over all, 245 feet; breadth over paddle-boxes, 60 feet; depth of hold, 30 feet 3 inches; tonnage, 1,940. She is to be propelled by two engines now fitting at Liverpool by Mr. Bury, of 220 horse-power each. The Forth is the third steam frigate already launched for the West India Royal Mail Steam-packet Company. The two first were built on the banks of the Clyde.

Steam-ship Building in Derry.—In Mr. Coppin's yard there has been laid the keel of a vessel intended for foreign trade, which, in point of dimensions, will come very little short of the largest steamers ever built, the proprietors of her being partly Englishmen. She is to be impelled by the Archimedean screw, to have a horse-power of between 500 and 600, and to be of 1,500 tons register. Her keel is 221 feet, only a few feet inferior to that of the greatest steamer launched, and her length over all will be 230 feet.—*Derry Journal.*

MISCELLANEA.

Westminster Bridge is again opened to traffic, after having, during the short period of four weeks, been subjected to extensive repairs. The well-known hollow arch has been removed, and spandrel walls with longitudinal arches in brickwork have been substituted, so as not only to strengthen the pier, but to remove a serious cause of danger, threatened by the pressure of the hollow arch on the haunches of the adjoining main arches. A rather unusual circumstance has been the removal and restoration of a whole course of stone throughout one arch. Great satisfaction has been given by the prompt and energetic manner in which the alterations have been effected by Mr. Cubitt, under the directions of the engineers, Messrs. Walker & Burgess.

Preston and Wyre Railway, Harbour and Dock Company.—Extract from a report to the directors by Captain Denham, at the last half-yearly meeting of the proprietors.—"The new channel through the 'Knot-spit,' and over the 'Little Ford,' has been so deepened as now to afford 13 feet of water at half tide through the straight course thus produced upon the line of lights direct from sea into the harbour. The present period is occupied in dredging up the shelving bottom between the landing wharf and 'Canshe-hole' anchorage, so as to produce a continuous depth of 12 feet at low water spring tides, an object we hope to attain by June next, during which the upper layer of shelving shore now interrupting the north or early approach to the wharf, will be excavated, leaving the under or lower shelf to be dredged down to 12 feet over the whole space across to 'Canshe-hole.' The dredge's service this year will thus be wholly dedicated to the wharf frontage and approaches. The new Channel to Sea will, however, be improved by excavating and carrying away at low water the remainder of the 'Knot-spit,' and trimming down the surface and marginal projections of the new cut or channel, the marl arising from which will be appropriated to the 'neckings' half tide wier about to be constructed on the opposite side of the channel. This latter work will also be prosecuted this year, and additional pontoons and stone flats are preparing for it. This tide wier will have the effect of concentrating the whole volume of back water, the scouring force of which has already been so essentially increased by the completion of the 'Knot-gulph' embankment."

Florence and Leghorn Railway.—A supplement to the *Florence Gazette* of the 27th April, contains the decree of H. I. and R. Highness, the Grand Duke of Tuscany, granting for the term of 100 years (to be reckoned from the time when it will be completed and opened to the public), the railway from Florence to Leghorn, to the Company announced by the Manifest of Fenzi and Senn of the 24th April, 1838, to be executed according to the report of the celebrated English engineer, Robert Stephenson, Esq. His Imperial and Royal Highness graciously allows said railway to bear his royal name of "Leopold," and grants numerous advantages and privileges, among others *the importation duty free, of all the iron works, machinery, locomotives, and every other article required for its construction, and completely placing it in active operation.* The exemption from the register stamp due on all the deeds of the company during the construction of the railway, the option of converting into perpetual leaseholds the amount of such lands as will be occupied by the company, and which may belong to the state, or to religious corporations, and which from its nature should be subject to re-investment. The right of expropriation fixed on a liberal basis, with the right of immediate occupation, and a low tariff for the transport of persons and goods.

Copper Mine.—The copper mine recently discovered in Jamaica is situate in Mount Vernon, a huge mountain six miles to the East of Kingston. The lodes run from east to west, with a dip to the north. The veins of ore are found in the neighbourhood of Lucky Valley estate, in the parish of Port Royal, and at the base of the mountain. The richest ore is a sulphurte, yielding 40 per cent. of metal. This ore is obtained in immense quantities from a shaft which opens on a small stream sufficient to carry away the debris. Several hundredweights have been sent to London and Swansea for smelting, great difficulty having been experienced in performing this operation perfectly in Jamaica, from the want of reverberatory furnaces. There is also a carbonate which yields 11 per cent. of metal by the humid process. This is a very beautiful ore, and occurs in what is called abon rock. The matrix consists principally of lime-stone, argillaceous sand-stone, slate, schist, and a fine black sand-stone. The black sulphuret, which is abundant, is obtained in masses resembling wet and rotten coals, soft when extracted from the mine, but hardens in the sun, and is full of pyrites. When dry it is perfectly friable. The situation of the mine is convenient, being only three miles and a half from the sea, and the road is a gradual descent to the harbour, Bull Bay, where there is good anchorage for vessels. It may be added that the mine is in full operation, a company having been formed, and all the shares bought up. When the packet left Jamaica, Senor Don Rennaldo, the captain of the Cuban mines, had been applied to for assistance and advice, and was daily expected there.

Consumption of Smoke.—We have great pleasure in directing public attention to the efficacy of Hall's apparatus for the consumption of smoke from steam engine chimnies. Mr. Hall has just completed one at the manufactory of Messrs. Boden and Morley, in Castle-street, in this Borough, which from its efficacy, if generally adopted, will leave no cause of complaint from what has hitherto been a source of annoyance to the inhabitants of the borough. The furnace is supplied by a current of air heated by the furnace itself, which, when in full operation, completely consumes the volume of dense smoke, which is frequently sent forth from the chimney of a steam-engine. Of course this cannot be done till the fire is got up in the morning, and whenever the furnace door is opened for feeding, the apparatus ceases to act; but half a minute suffices to clear the chimney, when the furnace door is shut, and then, however thick and dark the smoke was previously, the quantity is immediately greatly reduced and its density gives place to a silvery hue. We believe the apparatus saves something considerable in fuel, and we are sure its adoption will be hailed with general approbation by the inhabitants of this borough.—*Derby Reporter.*—A short time ago, our columns contained a notice of the perfect consumption of smoke by apparatus applied to the steam engine of Messrs. Benjamin Cort and Co., of this town; it has also been used with equal success as applied to other steam engines, both here and at Derby. We are highly gratified at being informed that this invention answers equally well with locomotive engines. A trial was made of it, as attached to the "Wizard," a few days ago, on the Midland Counties Railway, in the presence of some of the directors of the company, and of several other gentlemen; of the former were William Hannay, Esq., and Henry Youle, Esq., and of the latter were Francis Wright, Esq., of Lenton Hall, H. B. Campbell, Esq., &c., who all expressed their high approbation of its satisfactory operation. The above apparatus for which a patent was taken out in January last, is the invention of Mr. Samuel Hall, the inventor of the condensers (known under his name), for supplying pure distilled water instead of salt or otherwise impure water to the boilers of marine and other steam engines, as well as the inventor of the reefing paddle wheel for steam vessels. The importance to railway companies of being able to use coal instead of the costly article of coke to locomotive engines, can scarcely be estimated, so greatly must it reduce the expense of the transit of passengers and goods, and consequently increase the profits of the shareholders.—*Nottingham Review.*

Dorsetshire—The body of the church of St. Mary's, Wareham, Dorset, is now being pulled down for the purpose of being rebuilt. This part has evidently been already once before pulled down and rebuilt, the nave being divided from the side aisles by square massive piers of rough rubble construction, with impost and archivolt mouldings of a Roman character. This alteration was possibly done towards the latter end of the 17th, or beginning of the 18th century. The workmen have found in the walls some fragments of stone with curious carvings and inscriptions. There is a fine tower and spacious chancel of decorated Gothic which will not be touched, and attached is a small sepulchral chapel with tombs of cross legged knights in chain armour. The new church provides accommodation for 1000 persons. The contract has been taken by Messrs. Cornick and Son, of Bridport, Dorset, and the works are to be completed by Michaelmas 1842, under the superintendence of Mr. T. L. Donaldson, architect, by whom also a new Scotch Church is to be erected at Woolwich, in the Norman style, with accommodation for 1000 persons, half of whom will be soldiers of the garrison. The plot of ground for the church and schools, which are to be erected in connexion, has been given by the Government, in consideration of the sittings, which will be provided for the troops of the Kirk communion.

Mr. Stephenson's Lime Works at Amber Gate.—Mr. Stephenson has now commenced burning lime at these works, and is sending it to the different places adjacent to the North Midland Railway. In the course of a short time it will be conveyed to most of the principal towns in England. The kilns are built in a handsome and substantial form, standing from 30 to 40 feet above the surface of the ground. The limestone is procured from the village of Crich, about two or three miles distant from the kilns, on a tramway formed for that purpose. A short distance from Crich, the tramway passes through a tunnel between 50 and 60 yards in length; a little further on is an inclined plane, worked by a wheel, which lets down six wagons full of limestone, and draws up the same number of empty wagons. Nearly adjoining this is another inclined plane, which is uncommonly steep, rising at the rapid rate of one yard in three and a half, and is worked by a large drum, round which passes a wire-rope; a lever is attached to the drum, by which one man alone is able to regulate the speed of the wagons at pleasure, or stop them altogether. Two full wagons are let down and two empty ones are drawn up at the same time. The full wagons pass over the Cromford canal by a wooden bridge (elevated several feet above the surface of the water) to the top of the kilns. These stupendous works, when finished, will be of the most extensive character in England, or we may say in the whole world. They will, when complete, be able to turn out upwards of 200 tons of lime per day.—*Sheffield Patriot.*

Victoria Park Bill.—The Bill authorising the Woods and Forest to form a Park in the eastern part of the metropolis, has already past the House of Commons.

The bronze statue of Rubens is at length completed, and has been sent from Liege to Antwerp, the place of its destination.

Parisian Bitumen.—The terraces at the Slough station of the Great Western Railway are being lined with this material. its use has of late been considerably on the increase; it has been introduced in several parts of the metropolis.

LITERARY NOTICES.

Mr. Dollman has given the public two faithful representations of the restorations of the Vicar's Close at Wells, the details of which are given in Mr. Walker's book. The chimneys we think felicitous, but the sentry-box porches might, we conceive, without injury have been omitted by the architect; fidelity of this kind savours too much of the ingenuousness of the Chinese tailor, who treated the patches in the pattern coat as an essential part of the workmanship.

Mr. E. Clifford, a teacher of mathematics, has brought out a small treatise styled *Arithmetic Considerations on Marquoi's Parallel Scales, and the Protractor,* which contains a number of useful calculations and directions.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 29TH APRIL, TO 27TH MAY, 1841.

Six Months allowed for Enrolment.

JAMES SIMS, of Redruth, Cornwall, civil engineer, for "*certain improvements in steam engines.*"—April 29.

ALFRED JEFFERY, of Prospect-place, New Hampton, Middlesex, gentleman, for "*a new method of defending the sheathing of ships and of protecting their sides and bottoms.*"—April 29.

GEORGE TOWNSHEND, of Sorpcote-fields, Leicester, Esquire, for "*improvements in machinery or apparatus for cutting certain vegetable substances.*"—April 29.

JOSEPH GIBBS, of Kennington, civil engineer, for "*a new combinaiion of materials for making bricks, tiles, pottery, and other useful articles, and a machine or machinery for making the same, and also a new mode or process of burning the same, which machine or machinery and mode or process of burning are also applicable to the making and burning of other descriptions of bricks, tiles, and pottery.*"—April 29.

MILES BERRY, of Chancery-lane, for "*certain improvements in machinery or apparatus for making or manufacturing nails and brads.*" (A communication.)—May 4.

FRANCIS JOSEPH MASSEY, of Chadwell-street, Middleton-square, watch manufacturer, for "*improvements in the method of winding up watches and other time keepers.*"—May 4.

EDWARD NEWTON, of Leicester, manufacturer, and THOMAS ARCHBOLD, of the same place, machinist, for "*improvements in producing ornamentai or tambour work in the manufacture of gloves.*"—May 4.

CHARLES THOMAS HOLCOMBE, of Bankside, Southwark, iron merchant, for "*certain lubricating or preserving matters for wheels and axles, applicable also to the bearings, journals, or other parts of machinery.*"—May 4.

HUGH GRAHAM, of Bridport-place, Hoxton, artisan, for "*an improved manufacture of that kind of carpeting, usually denominated Kidderminster carpetting.*"—May 6.

MOSES POOLE, of Lincoln's Inn, Esquire, for "*improvements in the manufacture of fabrics by felting.*" (A communication.)—May 6.

PHILEMON AUGUSTINE MORLEY, of Birmingham, manufacturer, for "*certain improvements in the manufacture of sugar moulds, dish covers, and other articles of similar manufacture.*"—May 6.

JAMES HANCOCK, of Sidney-square, Mile End, civil engineer, for "*certain improvements in the manufacture of locks, keys, latches, and other fastenings, part of which improvements are applicable to taps and cocks for drawing off fluids.*"—May 6.

JOHN PAULY, jun., of Preston, Lancashire, manufacturer, for "*certain improvements in looms for weaving.*"—May 10.

HOOTON DEVERILL, of Nottingham, lace manufacturer, for "*certain improvements in machinery for making and ornamenting lace, commonly called bobbin net lace.*"—May 10.

ANDREW MC NAB, of Paisley, North Britain, engineer, for "*certain improvements in the manufacture of bricks.*"—May 11.

EDMUND TAYLOR, of King William-street, gentleman, for "*certain improvements in the construction of carriages used on railroads.*" (A communication.)—May 11.

HENRY PINKUS, of Maddox-street, Hanover-square, for "*an improved method or methods of applying electrical currents or electricity, either fractional, atmospheric, voltaic, or electro magnetic.*"—May 14.

JAMES GREGORY, coal master, and WILLIAM GREEN, turner, both of West Bromwich, Stafford, for "*certain improvements in the manufacture of iron and steel.*"—May 14.

PIERRE JOURNET, of Dean-street, Soho, engineer, for "*improvements in fire-escapes, which improvements are applicable to other useful purposes.*"—May 19.

JOHN CARR, junior, of Paddington, engineer, for "*improvements in apparatus for retarding and stopping railway-carriages.*"—May 20.

CHARLES PHILLIPS, of Chipping Norton, Oxford, engineer, for "*improvements in reaping and cutting vegetable substances as food for cattle.*"—May 20.

JOSEPH WOODS, of Lawn-place, Lambeth, Surrey, civil engineer, for "*certain improvements in locomotive engines, and also for certain inavrovements in the machinery for the production of rotatory motion for obtaining mechanical power, which improvements in machinery are also applicable for raising or impelling fluids.*"—May 22.

WILLIAM GALL, of Beresford-terrace, Surrey, for "*certain improvements in the construction of inkstands.*" (A communication.)—May 22.

JOHN AINSLIE, farmer, Redheugh, North Britain, for "*a new and improved mode of making or moulding tiles, bricks, retorts, and such like work from clay, and other plastic substances.*"—May 22; four months.

CHRISTOPHER DUMONT, of Mark-lane, London, for "*improvements in the manufacture of metallic letters, figures, and other devices.*" (A communication.)—May 22.

JOHN WINTERBORN, of Clarence-place, Hackney-road, surgeon, for "*improvements in machinery to facilitate the removal of persons and properly from premises, in cases of fire; which improvements are applicable to raising and lowering weights generally, to assist servants cleaning windows, and as a substitute for scaffolding.*"—May 22.

WILLIAM LEWIS RHAM, of Winkfield, Berks, clerk, for "*certain improvements in machinery or apparatus for preparing land, and sowing or depositing grain, seeds, and manure.*"—May 22.

JOHN WHITEHOUSE, of Deptford, engineer, for "*an improved method of making boilers, to be used in marine steam engines.*"—May 22.

WILLIAM JOEST, of Ludgate-hill, merchant, for "*improvements in propelling vessels.*" (A communication.)—May 26.

GEORGE HULME, of Saint John-street, Smithfield, cock founder, for "*improvements in water closets.*"—May 27.

JOSEPH BETTRIDGE, of Birmingham, wood turner, for "*an improved method of manufacturing papier mache, pearl, china, ivory, horn, wood, and composition, into pillars and stands for table and other lamps, and other articles of domestic furniture.*"—May 27.

JAMES SHANKS, of Saint Helen's, Lancashire, chemist, for "*improvements in the manufacture of carbonate of soda.*"—May 27.

TO CORRESPONDENTS.

Communications from M R., Daniel Clark, &c., *received too late will appear next month.*

We have received a proposition for forming "An Association of Architectural and Engineering Draughtsmen," which we have deferred for consideration until next month.

Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No.* 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

ERRATA.

In last month's Journal, p. 173, for *Harry* Austin read *Henry* Austin.

P. 129, for Mr. Edward Hall (late of *Birmingham*) read late of *Manchester.*

The type of pages 151 and 152, after it was made up, got disarranged; we have consequently reprinted them, which are given with the present number. We have to request our readers to cancel these pages, and substitute those given herewith.

the level of the engineman's eyes; and that the point where the centre of the beam would intersect the horizon, A C, of his vision at E, should be about 700 feet from the lens. The impulse of the light would be most advantageously received at some point as near the lens as is consistent with a full effect from a flame placed in its principal focus. A more remote observer would receive the rays diluted by distance: while a nearer approach of the eye to the lens would render it necessary to adopt an ex-focal arrangement, so as to cause convergence of the rays. By the latter arrangement their divergence would be decreased, and the space covered by the light would be lessened not only in proportion to the decrease of divergence, but also to that of the cosine of the beam's inclination to the horizon. Both these circumstances would therefore combine to curtail the duration of the impression on the eye.

It may naturally be expected that I should say something regarding the duration of the impulse of the light on the eye; and upon this topic I shall, in absence of actual experiment, content myself with stating briefly the result of my calculations. If we suppose that an effective divergence of only 2° were to be obtained (and this is just one third of what is obtained from Fresnel's lens with the great lamp), I find that the light would spread itself along the horizon of the observer's eye between B and C to the distance of about 1000 yards, which, at the speed of 40 miles an hour, would be passed over in about 50 seconds, but at the ordinary railway speed of 25 miles an hour, about 80 seconds or 1⅓ minute would be required. Such a flash of light falling upon the polished parts of the engine, and upon the observer's face, would undoubtedly act as a most effective signal. If, however, it should be thought advisable to increase the duration of the impression by spreading it over a greater length of the line, this effect could be easily produced by a slight alteration of the inclination of the lens, so as to cause the line of railway to cut the refracted beam more obliquely; but I by no means expect that any such modification would be found necessary in practice. The nearness of the eye to the lens, and the brilliancy of the flash, would, I am inclined to think, more than compensate for the shortness of the impression.

I must add a few words regarding the expense of these signals, which would be made up of the cost of erecting the scaffold of carpentry, the price of the lens, and the maintenance of the light. The price of the stage I shall pass over as a matter which may vary according to the circumstances of the situation and the taste of individuals; but the cost of the great annular lens does not exceed 40*l*.; and if a smaller sized lens, which I think would be found quite sufficient for the purpose, were employed, the expense would not be more than 10*l*. The annual maintenance would consist of little more than the supply of a gas or an oil burner. The consideration of the expense, therefore, of maintaining such a system of signals at the necessary intervals on railways, is not for a moment to be set against the most remote risk of the least of all the numerous accidents, the records of which fill the public prints.

OBSERVATIONS ON THE MOTIONS OF SHINGLE BEACHES.

By Henry R. Palmer, Esq., F.R.S.*

From the Philosophical Transactions of the Royal Society:—read April 10, 1834.

The extraordinary prevalence of tempestuous weather during the last autumn having occasioned numerous disasters on our coast, the public attention was directed in an unusual degree to the imperfections of many of the harbours, and more particularly to those which are encumbered with accumulations of shingle. The access to harbours thus circumstanced is generally uncertain, and in tempestuous weather is frequently dangerous, or even impossible.

The action of the sea, which gives motion to the shingles and produces the evils complained of, has long been a subject of speculation; but I have not found that it has been systematically investigated. Indeed, the contrariety of opinions advanced upon the subject, sufficiently indicates an entire absence of that satisfactory mode of inquiry which is essential to the foundation of a safe and practical deduction.

Very little has been written upon the subject; and such facts as have been mentioned have only been referred to incidentally, or with a view to geological science. My present object is exclusively practical in its nature, and my observations have been limited to such facts as would assist in establishing certain and fixed rules for controlling the motions of the beach, so far as to enable us to preserve a clear channel through it in all seasons, and in every variety of weather: and to accumulate and preserve the shingles, where it is needful to do so.

The subject at first sight appears greatly complicated; and were it necessary to discuss minutely all the modifications arising from the variety of forms and local circumstances, it would perhaps be too much so for general description. I have, however, limited my investig atin to those simple and unvarying laws to which nature always adheres; and therefore the following observations must be considered as restricted only to certain general principles, subject to a variety of modifications.

The principles which I propose to illustrate will (under similar circumstances) at all times exhibit the same phenomena, but for the sake of perspicuity I shall now only refer to the coasts of Kent and Sussex.

Section 1.

That the pebbles which compose the shingle beaches on these coasts are kept in continual motion by the action of the sea, and that their ultimate progress is in an easterly direction, are facts long known and commonly observed. The following observations are chiefly directed to the particular manner in which the motions are produced.

From a general view of the effects that I have noticed, it appears that the actions of the sea upon the loose pebbles are of three kinds: the first heaps up, or accumulates the pebbles against the shore; the second disturbs, or breaks down the accumulations previously made; and the third removes, or carries forward the pebbles in a horizontal direction.

For convenience I propose to distinguish these by the following terms, viz. the first, the accumulative action; the second, the destructive action; the third, the progressive action.

All the consequences resulting from these various actions are exclusively referrible to two causes. The one is to the current, or the motion of the general body of the water in the ebbing and flowing of the tides; the other to the waves, or that undulating motion given to the water by the action of the winds upon it; and it is of considerable importance to the present inquiry that the effects resulting from each specific cause be separately considered.

The motion of the shingles along the shore is commonly attributed to the currents, the action of the waves being considered only as a disturbing foace. That such a notion is erroneous will, I apprehend, presently appear; although I have to regret that I have not had the opportunity of obtaining such satisfactory information relating to the velocities of the currents in the channel, as would have enabled me to include every form of argument upon the subject. The absence of such information has also prevented me from deciding satisfactorily as to the sources from whence the whole body of shingle is derived, which, although not necessary for the practical purposes I have in view, would have given more interest to the subject, and would have rendered the elucidation more complete. I must, therefore, for the present, be content to pursue the motions of the beach after it is found lying along or near the shore; observing only that the materials of which it is composed are those of the various strata in the vicinity of the coasts, together with the ordinary sea sand, and such small particles as may have been brought to the shore by the floods of the various rivers.

That the current is not the force which moves the pebbles along the coast, will appear from the following reasons;

1st. If it were so, the direction of the motion of the pebbles would be determined by that of the currents: but while the direction of the currents will vary with the changes of the tides, we find that the direction of the pebbles may remain unaltered; and also that the motion of the pebbles is continued where no current exists.

2nd. Although the velocities of the currents may not have been ascertained with precision, yet it is known that the velocities generally along this coast, which can possibly act on the shingles, are not sufficient to give motion to pebbles of every dimension, which are in fact carried forward.

3rd. The motion of a current will not produce that order in which the pebbles are found to lie, which order (as will be hereafter shown) may easily be distinguished as the effect of the motion of the waves only.

The direction of the waves is determined principally by the wind, the prevailing direction of which on the coasts referred to is from the westward. Every breaker is seen to drive before it the loose materials which it meets; these are thrown up the inclined plane on which they rest, and in a direction corresponding generally with that of the breaker. In all cases we observe that the finer particles descend the whole distance with the returning breaker, unless accidentally deposited in some interstices; but we perceive that the larger pebbles return only a part of the distance; and upon further inspection we

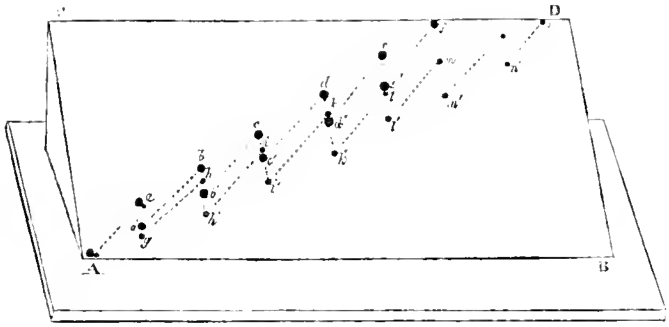
* The construction of harbours, piers, and breakwaters is likely to become of considerable importance to the engineering profession; we therefore propose to collect for publication in the Journal, such papers as have been written on the subject.

find that the distance to which each pebble returns bears some relation to its dimensions. This process is an indication of the accumulative action.

But under some circumstances, depending on the wind, it is found that pebbles of every dimension return with the breakers that forced them up the plane, and that these are accompanied also by others, which had been previously deposited, but which are in such cases disturbed by the waves; and by a continual repetition of the breakers acting in this manner, the whole of the shingle previously accumulated is immersed below the surface of the water. This process is an indication of the destructive action.

The particulars of the accumulative action, *combined with that of progression*, are explained as follows. (Fig. 1.)

Fig. 1.



Let A B C D be an inclined plane, representing that on which the loose pebbles move. Suppose the wind to blow in such a direction as to cause a wave to strike a pebble at A, in the direction of Aa, and to the distance a up the plane, that point being the extent to which the force can reach. Now here the wave breaks partly into spray, and is dispersed in all directions; is partly absorbed, and descends in a shallow form, which rapidly diminishes in its depth, so that the pebble is soon left exposed, and therefore does not return the whole distance with the water, but is left at rest at a' being at a higher level than that from whence its motion commenced.

With the rise of the tide the striking force is also elevated; and by the repetition of the operation described through the different heights in succession, the further motion of the pebble will be represented by a' b' b' b', &c., the distance in each step of its descent being something less than in that of its ascent, until it has reached the summit f, determined by the height of the tide. Now if we suppose a pebble of less dimensions than the former to be struck from the same point, we shall find it raised as before; but because its surface is greater in proportion to its weight, and because from its less bulk it remains longer immersed in the declining wave, it will descend further, and follow the line a g, &c., and will not be left at rest till it has reached o.

If, then, we suppose a pebble whose dimensions are less than either of the former, it will be evident that the point at which that will arrive on the highest level will be more distant still; hence it follows that the distance travelled horizontally by the pebbles during a tide will be in some proportion to their bulk, the specific gravities being the same.

(The pebbles do not in reality move in straight lines, but in a succession of curves; the straight lines are assumed here, and in other parts of this paper, to simplify the description.)

I trust it is only necessary to remark, that if the wind continue to blow in the same direction during the ebbing of the tide as through the flowing of it, the direction in which the waves will strike the shore will be nearly the same, and the progress of the pebbles will be urged by a similar action, and therefore their direction will also be the same.

In this action we observe a constant tendency to heap up and accumulate the shingles; and it is an interesting fact, that when the action has continued equally through a tide, the pebbles are left *in regular order, according to their dimensions*, the largest being uppermost, and the smallest at the bottom of the plane. I do not mean to state that all the largest are at the top, or that all the smallest are at the bottom, for it is evident that some of every size will be found at every level; but that if an equal measure (say half a peck) be taken from the different levels, the average of each specimen will exhibit in regular order the various dimensions.

The order in which the pebbles are thus found is, then, that by which the effect of the waves is distinguished from that of a current, the effect of the latter consisting only in its influence on the direction of the impinging and recoiling motions of the waves, by which the motion of the beach may in a small degree be accelerated or retarded.

Section 2.

In the illustration of that action of the sea which breaks down and removes an accumulation, I propose referring to my observations in the order in which they were made. My attention was first directed to this part of the subject in the neighbourhood of Sandgate in October last.

The accumulative action had been continued for a considerable time. The numerous groins erected near Folkstone to impede the progress of the beach, for the protection of the cliffs, had collected a bank of pebbles, which in some parts was five feet in height. The wind had so much abated as to be scarcely perceptible, but the sea had a motion denominated a *ground swell.*

The waves approached the shore nearly at right angles with it; but although in rapid succession, their forces were very moderate. These circumstances continued through five tides, by which time nearly the whole of the loose shingle had disappeared, including all that had been collected by the groins at Folkstone. The water being particularly clear, I was enabled to perceive distinctly the action upon the pebbles, and their motion downwards. I observed, that although every wave became broken and dispersed as usual, yet they followed in such rapid succession, that each wave rode over its predecessor while on its return, and thus produced a continual downward current, which carried with it the pebbles that were disturbed. That the pebbles were not removed far from the line of low water, would appear from the fact, that on the subsiding of the swell, it being succeeded by a light breeze of wind from the westward, the accumulation immediately commenced, and was restored to its former quantity by the action of four tides. I have subsequently had some favourable opportunities for making other observations on the effects produced by different rates of succession of the waves, and particularly at Dover, during the late gales, where the same actions were noticed. There I watched for an opportunity of witnessing that rate of succession which exhibited the destructive and accumulative actions in their smallest degrees; and I observed, that when ten breakers arrived in one minute, the destructive action was but just evinced; and that when only eight breakers arrived in the same period, the pebbles began to accumulate; which facts harmonized with my observations made at Sandgate and Folkstone, viz. *that the difference between the two actions was determined by the rapidity in succession of the waves upon the shores.*

In the description of the accumulative action, I have assumed the forces to be directed obliquely with the line of coast, and have therefore necessarily included the progressive motion; but it remains to be explained in what manner the shingles are carried forward while the destructive action is going on.

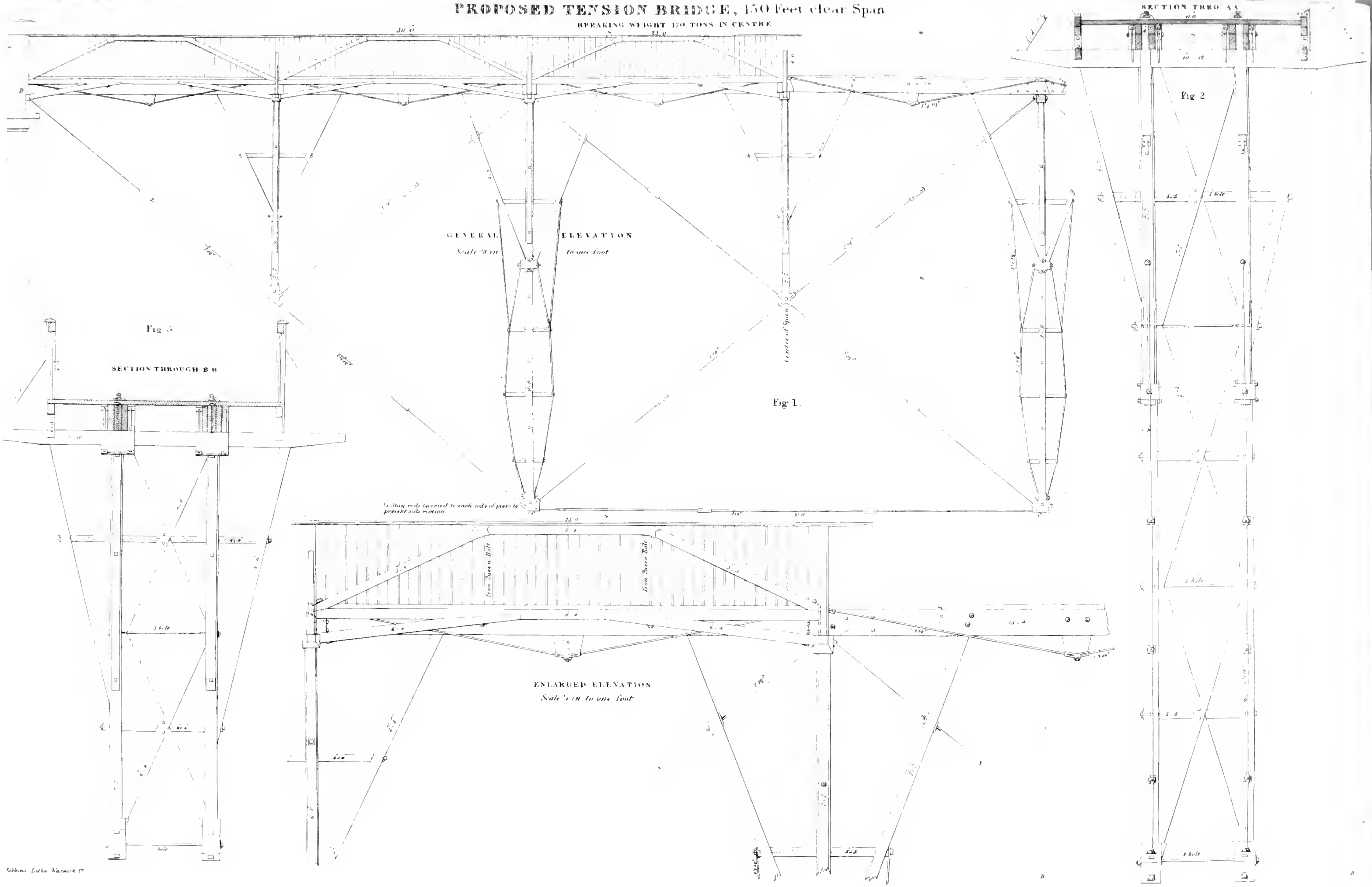
It is known that the action and re-action of the waves give to the whole body of the water, within a certain distance from the shore, an undulating motion. The direction of this motion, when approaching the shore, will, to a certain degree, correspond with that of the waves upon the surface, and the direction of the recoil will also be affected in like manner; therefore the pebbles that have been carried down by the destructive action are moved forward through an angular course *beneath the water*, until, by the excess of the impinging forces over those of the recoil, they are again raised by the action of the water, and deposited where the destructive action has ceased, or where, from local circumstances, it cannot occur. The circumstances which are most unfavourable to the destructive action are those which least admit of the constant downward under-current—an inlet, or narrow arm of the sea, for example. If we suppose a wave rolling through the mouth of an inlet, carrying with it a charge of shingles, it does not break as upon an inclined plane, but is dispersed in the general body of the water, which is comparatively quiescent; and there being no returning force, the shingle becomes deposited, and a bank is formed: and although the destructive process would act upon that bank if it could attain a certain height, yet the attainment of that height is prevented by the waves passing over it, and carrying with them, in succession, the shingles with which they are charged.

Section 3.

In Fig. 2 is represented a section of the beach formed along the outside of Folkstone Harbour. This section was taken with great accuracy, after the ground swell before referred to had removed most of the loose pebbles from it; so that the section may be considered as representing the plane upon which the progressive motion of the pebbles is carried on. Its slope is in the proportion of 1 to 9, nearly, and (with the exception of that part near the summit where there remained

PROPOSED TENSION BRIDGE, 150 Feet clear Span

BREAKING WEIGHT 170 TONS IN CENTRE

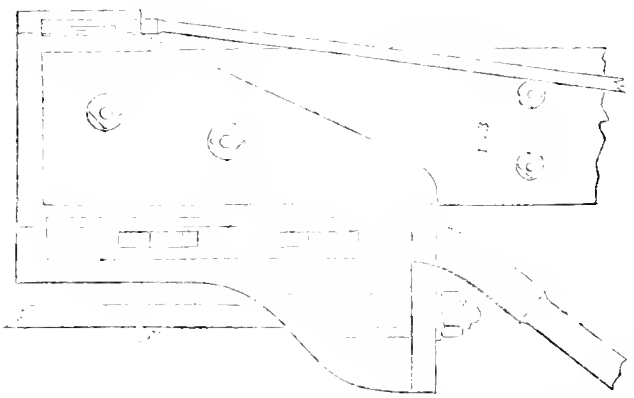


NEW FORM OF VIADUCT.

(With an Engraving, Plate VII.)

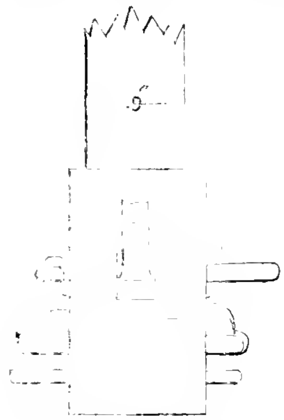
The accompanying drawings show a new species of viaduct that has been made use of as a general design, in the parliamentary estimate of a recently surveyed Railway.

Fig. 4—Side view of the Clutch Box D.



The principle in its simple form, is not new to the engineering world, having been put into execution in the "Foot bridge over the Whitadder, at Abbey St. Bathans," (see Theory, Practice, and Architecture of Bridges, part four,) and being commonly used in temporary erections, scaffolding, &c., and frequently applied in strengthening various kinds of vehicles. The novelty consists in carrying out the idea to the magnitude of the present case.

Fig. 5—End view of the Clutch Box C.

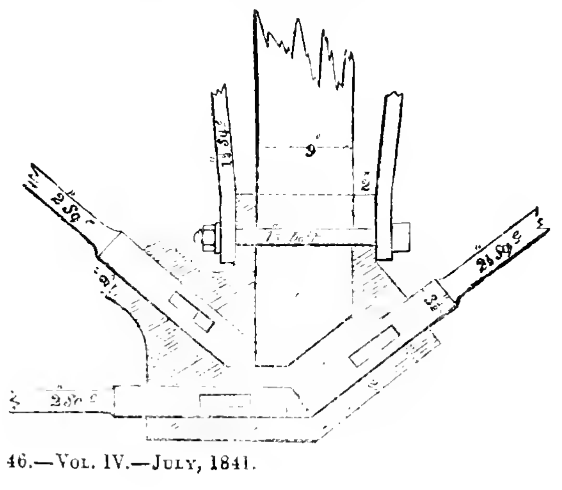


It will be seen that the system is applicable on a great scale, in those cases only where there is a large amount of headway to spare, as the efficiency of the arrangement is so completely dependant on the inclination of the tension bars. The estimation of the strength in the original form, is a matter of great ease, involving only a simple case of resolution of forces.

This design is made for a single line of rails only, but it would appear that it might be much more advantageously and economically applied to a double line.

A reference to the drawing will preclude the necessity of any detailed description, and it will be necessary merely to draw attention to the more important points. It will be seen that the application of the tension bars is not confined to the resistance to vertical deflection, but that it is made use of in given lateral strength to the main supports, (inverted tressels would perhaps be the most descriptive term), their bending being prevented in one direction by the transverse studs and tie-bolts, and in the other by the tension of the iron rods.

Fig. 6—Section of the Clutch Box C.



A weight entering upon the bridge will be perceived to immediately distribute its effects over the whole structure, by means of the ascending intermediate bars; these bars will effectually prevent any partial deflection that might be expected to occur upon an unequal distribution of the load.

It will be observed that rods are dotted in, and noted as being carried to the sides of the piers, to prevent any lateral oscillation: little fear of this however need be entertained, as the surface exposed to the wind would be so slight; nevertheless if there were any apprehension of such an effect, it might be further guarded against, by a divergence, of the sides of the supports, as shown by the dotted lines at D', D', on the transverse section; and this would be done with very little diminution of strength. In a double line there would be no need of such precaution.

The estimated cost, including scaffolding, &c., and exclusive of piers, is 5*l.* per lineal foot; the quantities I took out myself, and can bear testimony to their fulness; the prices were given by another, and were high in consequence of the difficulty of the localities: in short I believe that the above price is rather more than would be the cost in average cases. With regard to the strength, I think it will be found by any one who will be at the trouble to calculate it, that it is if any thing greater than what is stated.

To those with whom appearance is the main point in railway works, the design will probably afford some amusement; but every one will I think perceive that elegance of effect is not attempted, an economical and durable structure being the only object in view.

Herbert Spencer.

Derby, May 1[illegible], 1841.

Reference to Drawings.

Fig. 1. Plate VII. is a side view of the bridge, part of the span is omitted in order that the remainder might be kept to as large a scale as the size of the Journal would admit. Fig. 2. is a transverse section of one of the suspensions or the cross trusses; and fig. 3. a transverse section of the centre suspension or cross truss. Fig. 4. enlarged view of the clutch box D, secured to the piers. Fig. 5. end view of the clutch box C; and fig. 6. a section of the same. The three last figures are drawn to a scale of [illegible] of an inch to a foot.

CONDUCT OF THE GOVERNMENT TOWARDS THE ENGINEERING INTERESTS.

We have, on more than one occasion, thought it our duty to call the attention of our readers to the conduct which has long been pursued by the government and the legislature, as to all measures bearing upon the interests of the engineering profession. We are well aware that many of these measures, although weighing most strongly upon the engineers were directed against other interests, and cannot therefore be considered as purposely levelled against the profession: but, nevertheless, when we observe the tendency of measures more direct, and the uniform tenor of these proceedings, we are obliged to admit that either the policy or the inclination of the governing body is constantly directed to our injury. In whatever way we examine the measures affecting us we are impressed with this feeling, and now that we are enabled to look back and class together isolated events, we find an accumulation of evil in the highest degree threatening the profession. On the one hand our employment is proposed to be taken from us, and on the other we are to be placed under the government direction and control: so that both our moral and physical interests are equally concerned. It is perhaps fortunate that circumstances have intervened to prevent every attempt from being effective, but still a sufficient amount of mischief has been perpetrated to call for the serious attention of every one to the position in which he is placed. It might have been well at a former period for the civil engineer to say, that affects the marine engineer or the capitalist and not me, or for the practical engineer to say that has nothing to do with me, but now when we come to review the whole of these proceedings we find something which affects each individual branch, while there no longer remains a doubt that the whole body is in danger. What engineer when he considers the several government measures of the last four years can now flatter himself that he is safe, and that the attack on his neighbour is imminent of no danger to himself? Let him look at the Ten Per Cent. Deposit Clause, the Irish Railway Scheme, the Steam Navigation Bill and the Railways Bill; let him read the speeches of ministers, the reports of committees and commissioners, and the suggestions of commissioners, let him reflect on what has been attempted and then say if he dare to assign any limit to their future aggressions. We feel that the period has now arisen when it becomes the profession in a collective capacity to do in all its power for resisting present attempts, preventing future invasions, and remedying past evils, and unless these things be done and be done quickly too, we very much fear that an amount of distress and inconvenience will be inflicted on every individual, such as to make him bitterly regret his inactivity.

The Standing Order of the House of Commons requiring the payment of a deposit into the Bank of England of ten per cent. on the proposed capital of all public works, is a regulation the evils of which we have long deprecated. Many have shut their eyes under the delusion that either the order would be repealed from a conviction of its inefficiency, or such a change would take place in the money market as would enable it to be complied with. We were never so insane, for we considered that the same ignorance, which could lead to such an enactment in the teeth of reason and experience, would blind its partisans to any defect in its operations, and that whether the money market were either in a sound or unsound state, the impediment would be equally serious. The evils which have arisen to the profession from the stagnation of affairs have been quite enough without any aggravation, but now whatever may be the means or disposition of the monied interest, three years have passed over without a single act having passed for any public work of importance. After the present year we really cannot see where employment for a large part of the profession is to be obtained, for there will be neither railways, canals, docks, harbours, bridges, gas nor water works to be constructed, and no prospect, with means however abundant, of obtaining acts of parliament, except after the long period required by the standing orders. We foresaw what the result would be, and we gave warning of it, if therefore every one has remained lukewarm it has been from no default or neglect on our part, and those who will suffer will have themselves to blame for the event. The engineers must petition and obtain petitions from other parties for the redress of the grievances caused by the Ten Per Cent. Clause, for they may readily see that unless they put their shoulders to the wheel and sturdily too, no relief will they obtain. When an honourable member rose the last session to move for a reduction in the amount of the deposit, how was he supported, and what was the language of the President of the Board of Trade, the mouthpiece of that department in which all our evils have originated? He actually declared that no diminution in the number of acts had taken place, that no mischief was caused by the Standing Order, and finished by referring triumphantly to the number of notices then before the House of application for acts. Had he but enquired how many of these applications were rejected for non-compliance with this very regulation, and if he had enquired at the end of the session how many acts had passed, he would find that the account was merely a blank.

The Irish Railway Report, and the new Irish Railway scheme, are further developments of the same system; the progress of railways in Ireland has been checked, and the management of such as may be made is proposed to be entrusted to the government, the most inefficient body for the purpose which could possibly be selected, and which has already filled Ireland with monuments of jobbery and mismanagement. This new scheme must also be opposed as an emanation from the same stock, and as calculated by acting as a precedent to be productive of more immediate evil. The Steam Navigation bill exhibited, in all its deformity, the grasping ambition of the Board of Trade; the genius of our engineers was to be controlled, their plans revised, and their workshops taken from under their own management, and placed under the inquisitorial power of the government. The marine engineers were aroused, and the evil was warded off, but it must not be thought that an end is put to the existence of this monster, 'the snake is not killed but scotched,' and the spirit which animates it is too visible in the Railways Bill to allow us to doubt of its revival. These Railways Bills are too serious warnings of the danger of allowing the least tampering with our interests, to let us pass them by without calling the attention of our readers to the evils which are threatened by them. Discretionary powers are asked for, the future operation of which we are too well able to trace in those "shadows of coming events," the "Reports and Papers relating to Railways," presented to Parliament. Here we see military ignoramuses interfering with every part of the construction of railways and locomotives, putting the designs of the engineers under supervision, and suggesting that the workshop of the manufacturer of locomotives should be subjected to an inquisition. In fact, if our space permitted us, we might, on this subject alone, draw a fearful picture of the mischief which is threatened to every branch of the profession. Enough has now been said to call for an interference, and we have only to say further, that experience has shown that even the slightest opposition has been sufficient to check the Board of Trade in its mid-career, and if a sturdy opposition be organized, we are not without hopes of having all the grievances redressed. We again recommend the engineers to lose no time, or the profession will be stripped of its independence, and their offices of all appearance of business.

Neither are the evils confined to the engineers, but equally threaten other and more numerous classes. It is acknowledged that it is to the railways and other public works that we, in a great degree, owe the employment of the working classes, and diminution of the poor rates, and any sudden cessation of employment must be productive of the most disastrous consequences. The contractors, also and subcontractors employed, and the several classes of tradesmen and labourers connected with them, are exposed to consequences equally ruinous; not only will they be put out of work, but their plant, tools and materiel becoming useless, must be sold at ruinous prices. A large amount of capital, also, which was directly employed in promoting the progress of the nation, has been, during the suspension, diverted, being either hoarded or rendered comparatively idle. Considered, indeed, in every possible way, whether on the broadest grounds or the narrowest, the measures of the government equally refuse the test, the interests of the nation being sacrificed through narrow-mindedness, or a love of jobbery.

PLAN FOR A NEW ASSOCIATION OF ARCHITECTURAL AND ENGINEERING DRAUGHTSMEN.

Among the various means which may be adopted in order to attain any desirable object, the association of numerous individuals who have a common interest in it, is one which has often proved successful in cases where isolated energy would have been unavailing. This may be observed in various instances, whether in pursuits of public utility, of pleasure, of charity, or of a private advantage.

It is now intended to suggest to the consideration of these concerned, whether this principle of association, so largely applied at the present day to objects of great public concern, might not be made useful to those engaged in one department of the arts of design with which it has hitherto had perhaps but little connection.

That class of artists is here alluded to, who are employed in a subordinate capacity in preparing the necessary drawings required previously to the execution of any great work either of architecture or engineering, to furnish the necessary illustration for the artificers who are to carry it into practice, and for the proprietor who is to possess it when completed.

It may be true that the different societies already formed both of architects and engineers, may have the effect of adding to the general stock of information, of increasing the means of knowledge, and maintaining the character of each profession with the public; but the union now advocated, is intended to be of a more humble kind of utility, less exalted in its objects, less interesting to the imagination, but it is conceived, not less adapted to meet the wishes and supply the wants of a considerable number of individuals.

However it may be that the young student of architecture (by which perhaps he merely means the drawing of architectural decoration), flatters himself that he is pursuing a "fine art," including all the grand and elevating, and beautiful attributes that may be connected with the term, he will probably find sooner or later, (circumstanced as the art is in these utilitarian days), that he cannot pursue it professionally without making it a different sort of business: a pursuit in which the physical qualities of objects shall be more considered than the æsthetical, in which the combination of the various talents of others shall be preferred to the concentration of a single isolated mind upon a single visionary object, in which the useful shall triumph over the beautiful, and the matter of fact over the imaginative.

These observations are put forward as prefatory to the main object of this paper, which is to suggest the formation of an Association of Architectural and Engineering Draughtsmen, for the purpose of enabling them more readily to communicate with each other, and with those at whose hands they expect employment; and of affording to the latter class, the means of readily obtaining that assistance of which they may stand in need, on terms the most equitable to both parties.

To obtain these ends, the means now proposed are, the collecting together at a given place for public exhibition, a number of specimens of the abilities of members of the associated body, whether applied in the different ways which are found practically useful in business, or exerted to produce results more attractive to the eye at first sight. For there should not merely be a display of the heaven-ward aspirations of unfettered fancy, exerted upon castles in the air, bridges over chaos, temples for which even if already erected it would be difficult o contrive any useful destination, and palaces adapted to pursuits of pleasure, unsuitable to our tastes, our habits, and to the climate of the country we inhabit; but places should also be assigned to those working drawings of common houses, and modern economical churches, those practical details of machinery, and surveys of parishes, and plans of estates, which would perhaps attract still more scrutiny from some of the frequenters of the proposed exhibition.

In reducing this plan to practice, several reasons might be alleged why the draughtsmen themselves ought to be the managers. They might make it one of their rules to be allowed respectively space for their drawings proportionable to the sums they subscribe to defray the necessary expenses. On the other hand contributions might also be levied from those whose curiosity led them to visit the collection, by the sale of catalogues, the possession of which might give a right of admission for a certain period.

The writer of these observations would be glad if they should have any effect in inducing others of the parties interested to join and carry his proposal into effect. Of course he would not be backward in lending his share of assistance so far as was within his limited means, and he should expect to be joined in doing so by some other of the younger members of the profession, who have expressed their concurrence in the views here expressed.

G. M.

ENGINEERING WORKS OF THE ANCIENTS, No. 6.

In our last we gave an account from Xenophon of the Athenian silver mines, which, by some inadvertence, was detached from this series of papers, and now we proceed to give what Diodorus Siculus says as to the gold mines of Ethiopia (Book 3.)

EGYPTIAN OR ETHIOPIAN GOLD MINES.

In the confines of Egypt and the neighbouring countries of Arabia and Ethiopia there is a place full of rich gold mines, out of which with much cost and pains of many labourers, gold is dug. The soil here naturally is black, but in the body of the earth, run many white veins, shining with white marble, (query quartz), and glistering with all sorts of other bright metals; out of which, laborious miners, those appointed overseers, cause the gold to be dug up by the labour of a vast multitude of people. For the kings of Egypt condemn to these mines notorious criminals, captives taken in war, persons sometimes falsely accused, or such against whom the king is incensed; and that not only they themselves, but sometimes all their kindred, and relations with them, are sent to work here, both to punish them, and by their labour to advance the profit and gain of the king. There are infinite numbers upon these accounts thrust down into these mines, all bound in fetters, where they work continually, without being permitted any rest day or night, and so strictly guarded, that there is no possibility or way left to make an escape. For they set over them barbarians, soldiers of various and strange languages, so that it is not possible to corrupt any of the guard, by discoursing one with another, or by gaining opportunities of familiar converse.

The earth which is hardest and full of gold, they soften by putting fire under it, and then work it out with their hands; the rocks thus softened, and made more pliant and yielding, several thousands of profligate wretches break it in pieces with hammers and pickaxes. There is one workman who is the overseer of the whole work, who marks out the stone, and shows the labourers the way and manner how he would have it done. Those that are the strongest amongst them, that are appointed to this slavery, provided with sharp iron pickaxes, cleave the marble shining rock by mere force and strength, and not by art of sleight of hand. They undermine not the rock in a direct line, but follow the bright shining vein of the mine. They carry lamps fastened to their foreheads to give them light, being otherwise in perfect darkness in the various windings and turnings wrought in the mine; and having their bodies appearing sometimes of one colour and sometimes of another (according to the nature of the mine where they work). They throw the lumps and pieces of the stone cut out of the rock upon the floor. And thus they are employed continually without intermission, at the very nod of the overseer or taskmaster, who lashes them severely besides. And there are little boys that attend upon the labourers in the mines, and with great labour and toil gather up the lumps and pieces hewn out of the rock as they are cast upon the ground, and carry them forth and lay them upon the bank. Those that are about thirty years of age take a piece of the rock of such a certain quantity, and pound it in a stone mortar with iron pestles till it be as small as a pea, then those little stones so pounded are taken from them by the women and older men who cast them into mills that stand together near at hand there in a long row, and two or three of them being employed at one mill, they grind it so long till it be as small as fine meal, according to the pattern given them. No care at all is taken of the bodies of these poor creatures, so that they have not a rag so much as to cover their nakedness, and no man that sees them can choose but must commiserate their sad and deplorable condition. For though they are sick, maimed or lamed, no rest nor intermission in the least is allowed them, neither the weakness of old age nor the infirmities of women are any plea to excuse them; but all are driven to their work with blows and cudgelling, till at length overborne with the intolerable weight of their misery, they drop down dead in the midst of their insufferable labours; so that these miserable creatures always expect worse to come than that which they at present endure, and therefore long for death as far more desirable than life.

At length the masters of the work take stone thus ground to powder, and carry it away in order to the perfecting of it. They spread the mineral so ground upon a broad board somewhat hollow and lying shelving, and pouring water upon it, rub it and cleanse it, and so all the earthy and drossy parts being separated from the rest by the water, it runs off the board, and the gold by reason of its weight remains behind. Then washing it several times again, they first rub it lightly with their hands, afterwards they draw up the earthy and drossy matter with slender sponges gently applied to the powdered dust, till it be clean pure gold. At last other workmen take it away by weight and measure, and they put it into earthen urns, and according to the quantity of the gold in every urn, they mix it with some lead, grains of salt, a little tin, and barley bran; then covering the pot close, and carefully daubing them with clay, they put them in a furnace where they abide five days and nights together; then after a convenient time that they have stood to cool, nothing of the other matter is to be found in the pots, but only pure refined gold, some little diminished in the weight.

And thus is gold prepared in the borders of Egypt, and perfected and completed with so many and so great toils and vexations. And therefore I cannot but conclude that nature itself teaches us, that as gold is got with labour and toil, so it is kept with difficulty, creates everywhere the greatest cares, and the use of it is mixed both with pleasure and sorrow. Yet the invention of those metals is very ancient, being found out, and made use of by the ancient kings

Assyrian Engineering.

Keeping Diodorus Siculus as our guide, we now come to such notes as he has left of Assyrian engineering. (Book Second.)

WALLS OF NINEVEH.

Ninus (1950 B.C.) is styled the builder of Nineveh, having provided money and treasure and other things necessary for the purpose, he built a city near the river Euphrates, very famous for its walls and fortifications, of a long form; for on both sides it ran out in length above a hundred and fifty furlongs; but the two lesser angles were only ninety furlongs a piece; so that the circumference of the whole was four hundred and fourscore furlongs. And the founder was not herein deceived, for none ever built the like, either as to the largeness of its circumference, or the stateliness of its walls; for the wall was a hundred feet in height, and so broad that three chariots might be driven together upon it abreast. There were fifteen hundred turrets upon the walls each of them two hundred feet high.

BABYLON.

Semiramis, the wife of Ninus, was the founder of Babylon. To this end having provided architects, artists, and all other necessaries for the work, she got together two millions of men out of all parts of the empire to be employed in the building of the city. It was so built that the river Euphrates ran through the middle of it, and she compassed it round with a wall of three hundred and sixty furlongs in circuit, and adorned with many stately turrets; and such was the state and grandeur of the work, that the walls were of that breadth that six chariots abreast might be driven together upon them. Their height was such as exceeded all men's belief that heard of it (as Ctesias Cnidius relates). But Clitarchus, and those who afterwards went over with Alexander into Asia, have written that the walls were in circuit three hundred and sixty-five furlongs; the queen making them of that compass, to the end that the furlongs should be as many in number as the days of the year. The walls were of brick cemented with asphalte; in height, as Ctesias says, fifty fathoms; but as some of the later writers report, but fifty cubits only, and that the breadth was but little more than what would allow two chariots to be driven afront. There were two hundred and fifty turrets in height and thickness proportionable to the largeness of the wall. It is not to be wondered at that there were so few towers upon a wall of so great circuit, seeing that in many places round the city, there were deep morasses; so that it [illegible] year's [illegible] progression, she [illegible] over the [illegible] piers of the river five furlongs in [illegible] the supports [illegible] of the arches with great art [illegible] in the bottom of the water twelve feet distance from each other. That the stones might be the more firmly joined, they were bound together with hooks of iron, and the joints filled up with molten lead. And before the pillars she made defences sterlings with sharp pointed angles, to receive the water before it beat upon the flat sides of the pillars, which caused the course of the water to run round by degrees gently and moderately as far as to the broad sides of the pillars, so that the sharp points of the angles cut the stream, and gave a check to its violence, and the roundness of them by little and little giving way, abated the force of the current. This bridge was floored with great joists and planks of cedar, cypress and palm trees, and was thirty feet in breadth, and for art and curiosity yielded to none of the works of Semiramis. On either side of the river she raised a bank, as broad as the wall, and with great cost drew it out in length a hundred furlongs. Semiramis built likewise two palaces at each end of the bridge, upon the bank of the river, whence she might have a prospect over the whole city, and make her passages as by keys to the most convenient places in it as she had occasion. And whereas Euphrates runs through the middle of Babylon, making its course to the south, the palaces lie the one on the east, and the other on the west side of the river, both built at exceeding cost and expense. For that on the west had a high and stately wall, made of burnt brick, sixty furlongs in compass; within this was drawn another of a round form, upon which were pourtrayed in the bricks, before they were burned, all sorts of living creatures, as if it were to the life, laid with great art in curious colours. Our author goes on further to describe the ornaments of the palaces, which as less connected with our object we omit. He also describes the formation of a vaulted passage between the two palaces under the Euphrates, made by diverting the river. He says that the walls of this vault were twenty bricks in thickness, and twelve feet high, beside and above the arches; and the breadth was fifteen feet. The arches were of firm and strong brick, and plastered all over on both sides with bitumen four cubits thick. This piece of work being finished in two hundred and sixty days, the river was turned into its ancient channel again.

SEMIRAMIS'S WAY.

In a march towards Ecbatana, Semiramis arrived at the mountain Larcheum, which being many furlongs in extent, and full of steep precipices and craggy rocks, there was no passing but by long and tedious windings and turnings. To leave therefore behind her an eternal monument of her name, and to make a short cut for her passage, she caused the rocks to be hewn down, and the valleys to be filled up with earth, and so in a short time at a vast expense laid the way open and plain, which to this day is called Semiramis's way.

AQUEDUCT AT ECBATANA.

Besides this road, when she came to Ecbatana, which is situated in a low and even plain, she built there a stately palace, and bestowed more of her care and pains than she had done at any other place. For the city wanting water, (there being no spring near) she plentifully supplied it with good and wholesome water, brought thither with a great deal of toil and expense after this manner. There is a mountain called Orontes, twelve furlongs distant from the city, exceedingly high and steep for the space of five and twenty furlongs (query) up to the top; on the other side of this mountain there is a great lake which empties itself into the river. At the foot of this mountain she dug a canal fifteen feet in breadth and forty in depth, through which she conveyed water in great abundance into the city.

BRIDGE OF BOATS.

In her expedition into India, Diodorus relates that to cross the river, she carried with her boats, and made a bridge of boats by which she crossed.

SEMIRAMIS DEIFIED.

After her death or disappearance, Semiramis was adored by the Assyrians in the form of a dove, it being believed that she was enthroned among the gods.

MEMNON'S CAUSEWAY.

Of this work Diodorus gives the following account. Memnon, the [illegible] Persians [illegible] which is called Memnon's [illegible] Egypt question this, and say that Memnon was [illegible] and show several ancient palaces, which (they say) retain his name to this day, being called Memnon's palaces.

We shall now cull from the Fifth Book of Diodorus a number of desultory notes on different subjects, and first as to the

IRON MINES OF ETHALIA.

This island (Elba) abounds with iron stone, which they dig and cut out of the ground to melt, in order for the making of iron: much of which metal is in this sort of stone. The workmen employed first, cut the stones in pieces, and then melt them in furnaces, built and prepared for the purpose. In these furnaces, the stones by the violent heat of the fire, are melted into several pieces, in form like to great sponges, which the merchants buy by truck and exchange of other wares, and transport them to Dicearchia, and other mart towns.

TIN MINES OF BRITAIN.

Now we shall speak something of the tin which is dug and gotten here. They who inhabit the British promontory of Belerium, by reason of their converse with merchants, are more civilized and courteous to strangers than the rest are. These are the people that make the tin, which with a great deal of care and labour they dig out of the ground: and that being rocky, the metal is mixed with some veins of earth, out of which they melt the metal, and then refine it. Then they beat it into four square pieces like to a die, and carry it to a British Isle near at hand, called Ictis (Wight).*

GOLD MINES OF GAUL—ARMS.

In Gaul there are no silver mines, but much gold, with which the nature of the place supplies the inhabitants, without the labour or toil of digging in the mines. For the winding course of the river washing with its streams the foot of the mountain, carries away great pieces of golden earth: and when it is so done, they cleanse them from the gross earthy part, by washing them in water, and then melt them in a furnace: and thus get together a vast heap of gold, with which not only the women, but the men deck and adorn themselves.

As the arms used by the Gauls are calculated to show the progress made by them in the working of other metals, we copy the following descriptions. Some carry on their shields the shapes of beasts in brass, artificially wrought, as well for defence as ornament. Upon their heads they wear helmets of brass, with large pieces of work raised upon them for ostentation sake, to be admired by the beholders; for they have either horns of the same metal joined to them, or the shape of birds and beasts carved upon them. Some of them wear iron breastplates, and hooked; but others, content with what arms nature affords them, fight naked. For swords they use a long and broad weapon called *spatha*, which they hang across their right thigh by iron or brazen chains. Some gird themselves over their coats, with belts, ornamented with gold or silver. For darts they cast those they call lances, the iron shafts of which are a cubit or more in length, and almost two hands in breadth.

CELTIBERIAN MODE OF PREPARING IRON.

They carry two edged swords exactly tempered with steel, and have daggers beside of a span long, which they make use of in close fights. They make weapons and darts in an admirable manner, for they bury plates of iron so long under ground, till the rust hath consumed the greater part, and so the rest becomes more strong and firm: of this they make their swords and other warlike weapons, and with these arms thus tempered, they so cut through every thing in their way, that neither shield, helmet, nor bone can withstand them.

SILVER MINES OF SPAIN.

Having related what concerns the Iberians, we conceive it not impertinent to say something of their silver mines; for almost all this country is full of such mines, whence is dug very good and pure silver; from which those who deal in that metal gain exceeding great profit. The Pyrenean mountains are the highest and greatest of all others, and being full of woods, and thick of trees, it is reported that in ancient time this mountainous tract was set on fire by some shepherds, and continuing burning for many days together, (whence the mountains were called Pyrenean or fiery), the parched superficies of the earth sweated abundance of silver, and the ore being melted, the metal flowed down in streams of pure silver, like a river; the use whereof

* Valso, Spain.

being unknown to the inhabitants, the Phenician merchants bought it for trifles given for it in exchange, and by transporting it into Greece, Asia and all other countries, greatly enriched themselves: and such was their covetousness, that when they had fully laden their ships, and had much more silver to bring aboard, they cut off the lead from their anchors, and made use of silver instead of the other. The Phenicians for a long time using this trade, and so growing more and more wealthy, sent many colonies into Sicily and the neighbouring islands, and at length into Africa and Sardinia: but a long time after the Iberians coming to understand the nature of the metal, sunk many large mines, whence they dug an infinite quantity of pure silver, (as never was the like almost in any other place of the world), whereby they gained exceeding great wealth and revenues. The manner of working in these mines, and ordering the metal among the Iberians is thus: there being extraordinary rich mines in this country of gold, as well as of silver and brass, the labourers in the brass take a fourth part of the pure brass dug up, to their own use, and the common labourers in silver have a Euboick talent for their labour in three days time: for the whole soil is full of solid and shining ore, so that both the nature of the ground, and the industry of the workmen is admirable. At the first every common person might dig for this metal, and in regard that the silver ore was easily got, ordinary men grew very rich; but after Iberia came into the hands of the Romans, the mines were managed by a throng of Italians, whose covetousness loaded them with abundance of riches, for they bought a great number of slaves, and delivered them to the task masters and overseers of the mines. These slaves open the mouths of the mine in many places, where digging deep into the ground, are found massy clods of earth, full of gold and silver: and in sinking both in length and depth, they carry on their works in undermining the earth many furlongs distance, the workmen every way here and there making galleries under ground, and bringing up all the massy pieces of ore, (whence the profit and gain is to be had), even out of the lowest bowels of the earth. There is a great difference between these mines and those in Attica; for besides the labour, they that search there are at great cost and charge; and besides are often frustrated of their hopes, and sometimes lose what they had found, so that they seem to be unfortunate to a proverb. But those in Iberia who deal in mines, according to their expectations, are greatly enriched by their labours: for they succeed at the very first sinking, and afterwards by reason of the extraordinary richness of he soil, they find more and more resplendent veins of ore, full of gold and silver; for the whole soil round about is interlaced on every hand with these metals. Sometimes at a great depth they meet with rivers under ground, but by art give a check to the violence of their current; for by cutting of trenches under ground, they divert the stream: and being sure to gain what they aim at, when they have begun, they never leave till they have finished it; and to admiration they pump out those floods of water with those instruments called Egyptian pumps, invented by Archimedes the Syracusan, when he was in Egypt. By these with constant pumping by turns they throw up the water to the mouth of the pit, and by this means drain the mine dry, and make the place fit for their work. For this engine is so ingeniously contrived, that a vast quantity of water is strangely with little labour cast out, and the whole flux is thrown up from the very bottom to the surface of the earth. The ingenuity of the artist is justly to be admired, not only in these pumps, but in many other far greater things, for which he is famous all the world over, of which we shall distinctly give an exact enumeration, when we come to the time wherein he lived. Now though these slaves that continue as so many prisoners in these mines, incredibly enrich their masters by their labour, yet toiling night and day in these golden prisons, many of them by being over wrought, die under ground; for they have no rest or intermission from their labours; but the taskmasters by stripes force them to intolerable hardships, so that at length they die most miserably. Some that through the strength of their bodies, and vigour of their spirits are able to endure it, continue a long time in those miseries, whose calamities are such, that death to them is far more eligible than life. Since these mines afforded such wonderful riches, it may be greatly admired that none appear to have been sunk of later times; but in answer thereunto the covetousness of the Carthaginians, when they were masters of Spain, opened all.

In many places of Spain there is also found tin; but not upon the surface of the ground as some historians report, but they dig it up, and melt it down as they do gold and silver. Above Lusitania there is much of this tin metal that is in the islands lying in the ocean over against Iberia, which are therefore called Cassiterides; and much of it is likewise tranported out of Britain into Gaul, the opposite continent.

(To be continued.)

HISTORICAL SKETCH ON THE USE OF BRONZE IN WORKS OF ART.

By César Daly, Architect.

(Translated for the Civil Engineer and Architect's Journal, from the Revue Générale de l'Architecture.)

Some years ago, many, otherwise remarkable for their learning, would ask in what degree modern civilization differed from that of ancient Greece or Rome: and even in the present day there are some who will ask the same question, even in England, in the heart of London, or of Manchester, or of Birmingham, with a thick cloud of coal smoke from a hundred factories rolling in volumes over their heads. To these a feature so extraordinary, unknown to the ancients, tells no tale, though it is one which marks most strongly the character of modern times, superior in its power over physical nature, and the great development it has given to the efforts of mechanical invention. So generally, indeed, is the industrial character of modern times unnoticed, that we have scarcely any accounts of the various branches of manufactures, or of the subject generally, although this practical history is one which has the greatest interest in relation to the human race. This history in all its ramifications, whether as to the tools employed or the materials upon which they are exercised, would open a wide field of research, capable of ample gratification, notwithstanding the manner in which the records are dispersed. Among the metals and their alloys known at an early period, none has been devoted to such important uses as bronze, to which we shall devote the present essay.

Had the art of metallurgy been better known in distant periods, and the use of iron and steel more prevalent at a former epoch, or even had copper been more extensively used, we should have remained ignorant of much of the material history of antiquity, for both of the former metals disappear under the influence of rust, and copper is also a sufferer from the action of damp. Thus, while in the Portici Museum the bronze articles are well preserved, those of copper have been more or less affected, and those of iron are scarcely recognizable.

Copper was known in the earliest times, and is mentioned by Moses; but the difficulty of working it with the hammer, and the high degree of heat requisite to melt it, greatly limited its use. It was fortunately not long before the properties of a mixture of copper and tin were discovered, a mixture with greater tenacity and resistance than copper alone, fusible at a lower temperature, and denser than the mean of its components. By this mixture was obtained a metal which readily flowed into every part of the mould, so as to take a correct impress of the pattern, while it was hard enough to wear well, was not brittle, and so far from being injured by oxidation, which only affected it slightly, it was preserved by it from the action of the atmosphere, taking the beautiful colour which is so much admired. The providential discovery of these properties doubtless gave a great impulse to the infant civilization of the early stages of society, affording at the same time a greater facility for manufacture united with greater durability. Thus it came to be employed for arms and edge tools by all the nations of antiquity, whether Indians, Chinese, Egyptians and Hebrews, Greeks, Etruscans, Romans or Celts. In connexion with them, indeed, it might be well said that for many long ages bronze was the iron of the ancients. The fine arts were not long in making use of it, and we find it ministering to the decoration of many of the most ancient monuments of Egypt. In Scripture we find that the Philistines, after the capture of Sampson, loaded him with chains of brass, and Josephus relates that Solomon employed Hiram of Tyre to make two columns of bronze richly decorated, eighteen cubits high, twelve cubits in circumference, and four inches in thickness, or four times as thick as that on the Column of July. The columns were placed at the entrance of the porch of the Temple at Jerusalem. From these works we may judge that working in copper and brass was already of old date at this distant period.

We are quite in the dark as to the processes of melting and forms of the furnaces used by the ancients; but we can readily judge, from the interest, in these days of the progress of science, still attached to the casting of bronze on a large scale, of the difficulties to which workmen must have been subjected in the rude state of chemistry and metallurgy. In Greece the use of bronze was very common; the Chalciæcos, at Lacedemon, was a temple of bronze, dedicated to Minerva, and executed about 750 years before the Christian era by the celebrated Gitiadas, poet, sculptor, and architect. Every part of this building, from the top to the bases of the columns, was entirely covered with plates of bronze decorated with mythological sculptures. Pausanias (B. 10, ch. 5,) relates that when the temple of Apollo at Delphi was rebuilt for the third time, it was constructed of copper, which is not surprising, adds he, as Aerisius had a bronze room made for his daughter, and as there is still to be seen at Sparta the temple of Minerva Chalciaecus. He goes on further to say, "at Rome, the place in which justice is administered excites surprise by its grandeur and magnificence: but what is most admired is a bronze ceiling, which extends from one side to the other. The same author, who attributes to Theodosius and Racos of Samos the discovery of founding statues in bronze, informs us that it was about the year [illegible] before our era that this art was first practised. This, like all the other arts, made great progress in the time of Pericles, but did not reach its full height until the age of Alexander, when each of the principal cities of Greece possessed several thousand figures of bronze, among which were some enormous colossi. This is what Pliny says in his 24th book, sec. 18, "There are numberless instances of boldness in this art, for we see that enormous colossal masses have been executed as large as towers. Such is the Apollo of the Capitol, brought from Apollonia, a city of Pontus, by M. Lucullus; this is thirty cubits high, and cost fifty talents. Such is the Jupiter of the Campus Martius, consecrated by the Emperor Claudius, and called Pompeian, because it is near Pompey's Theatre; such is that of Tarentum, executed by Lysippus, and which is forty cubits in height. What is most remarkable as to this figure is, that it is so well balanced that it may be moved by the hand, although it could not be upset by a whirlwind. The most admired of these colossi was that of the Sun at Rhodes, made by Chares of Lindus, a pupil of Lysippus. This figure was seventy cubits high, was overturned 56 years after its completion by an earthquake; but cast down as it is, it still excites admiration. Very few men can put their arms round the thumb, the fingers are bigger than most statues, and the hollows in the broken limbs are like the yawning mouths of caves: inside are seen stones of large size, which were used to settle it on its base. It is said to have been finished in twelve years, and to have cost three hundred talents, a sum produced by the warlike engines of King Demetrius, when he raised the siege of Rhodes. In the city are a hundred other smaller colossi, each of which would be worthy of bestowing distinction on the town in which it might be placed; besides these are five colossi of gods by Bryaxis. Italy has also produced colossi, for we see in the library of the temple of Augustus, the Tuscan Apollo, which is fifty feet high from the toe, and in which it is difficult to tell which to admire most, the bronze or the beauty of the workmanship. Spurius Carvilius had a Jupiter made for the Capitol out of the helmets, cuirasses and greaves of the conquered Samnites. The size of this statue is such that it may be seen from the place in which is the Latial Jupiter. But in our times, Zenodorus has surpassed all the figures of this kind in height, in the Mercury which he made for a city of the Gauls in Auvergne. This was ten years in execution, and cost four hundred thousand sisterces."

It is probable that these colossi were formed of a number of pieces secured with nails, like so much brazier's work, for it is thus that the ancients made their metal statues before they had acquired the art of founding. At Lillebonne in Normandy, a few years ago, in the course of the excavations for uncovering the Roman theatre, a bronze Mercury was found made in this manner. In reading the travels of Pausanias in Greece, we cannot but feel surprised at the immense number of bronze works in sculpture which he meets with at every step, particularly when we recollect that this country has been in the possession of the Romans for three centuries, and that they had already, on several occasions, carried away thousands of bronze figures. Of 33 colossi described by the tourist, 30 were of bronze, the three others of wood; he also describes 32 equestrian statues of bronze and 24 chariots, at least of natural size, sometimes with two, and oftener with four horses, and holding one or two figures. Some were accompanied by runners or grouped with men on foot who led them; in fine, he mentions more than [illegible] animals of considerable size, also of bronze. And yet Pausanias only visited a part of Greece. It was of bronze that the Athenians, after the death of Pisistratus, formed the first quadriga, in memory of their fellow countrymen who died while fighting for their native land. Of bronze also is constructed, in our days, the Monument of July. Bronze is, in truth, the symbol of strength, and it is interesting to observe how the same metal has been chosen, at two periods so remote, to consecrate the remembrance of facts having so much resemblance.

The Romans, as we have seen from extracts before given, made frequent use of bronze, and like the Greeks, employed it in the form of candelabræ, lamps, furniture, triclinia, altars, tripods, tools, fastenings, letters for monumental inscriptions, window fastenings, &c. The doors were sometimes plated with bronze, secured with nails of the same metal; such as those of the Pantheon. Pliny (B. 34, § 7,) says that the ancients were accustomed to make the threshold and gates of temples of bronze. Ancient gates entirely formed of bronze are still to be seen in the church of St. Cosmo and St. Damian in the Forum at Rome, formerly the temple of Romulus and Remus, and this luxury was not exclusively confined to temples, for, 380 years before our era, the ornaments were of bronze on the doors of the house of Camillus. By means of cramps large masses of bronze ornaments and carvings were fastened on monuments by way of decoration. On bronze tablets were engraved laws, treaties of peace, and public acts intended to be made known to posterity. Three thousand of these tablets were destroyed in the fire of the Capitol, in the time of Vespasian. Capitals were also made of bronze, which were secured on cores of stone. Pliny relates that "C. Octavius, who conquered Perseus in a naval action, erected, in honour of his triumph, a double portico, which was called Corinthian because the capitals of the columns were of bronze; this portico was near the Flaminian Circus; the capitals of the Pantheon, placed there by Agrippa, are of the same metal." The Romans further applied bronze in the execution of works on a large scale; the framing of the Pantheon was constructed of bronze, and, according to Serlio, who had examined it in its place, the different pieces were hollow; they were put together in the same way as woodwork. The caissons of the vault of this monument were also of bronze, and the circle which frames the opening by which the Rotunda is lighted still remains. In the baths of Caracalla the ceiling of the immense hall known as the Cella Solearis was formed of a net-work of bronze; a fact of which M. Blouet did not seem to be aware when he published his restoration of that monument. The ancients also constructed roofing of bronze, for at Rome, 212 years before the Christian era, the temple of Vesta, at Rome, was covered with tiles of bronze, and so, at a later period, was the Pantheon. As to bronze statues, there was at Rome a number truly prodigious, brought from all the great cities of Etruria, Greece, Sicily, and Asia Minor. Scaurus having erected a temporary theatre at Rome, towards the end of the republic, decorated it with three thousand of these statues.

The art of the founder naturally underwent all the vicissitudes of the other arts; in the time of Nero the decadence had already commenced, it not being possible to cast the colossal statue of that emperor, modelled by Zenodorus, and which was to have been 110 feet high,* although a century afterwards the beautiful equestrian statue of Marcus Aurelius was cast. Falconnet, in comparing these two facts, endeavours to make out a case for an attack on Pliny; but it seems to us that the circumstances may be reconciled by supposing that casting in bronze had been momentarily neglected before the time of Zenodorus, and that they had been more successfully cultivated in the time of Marcus Aurelius, for a similar circumstance happened in our own days. The brothers Keller, under Louis XIV., carried the art of casting in bronze to a high degree of perfection; but under Louis XV. the founders were not so good; and in the early part of the empire, great difficulties were met with in executing works of this kind, whilst now the art of casting in bronze has made greater progress than ever. Besides, it may be said that whenever a process is not carried on scientifically, while the reason of the different phenomena has not been discovered, and the artist consequently is reduced to take the bare results of experience for his guide, the neglect of the art for some time is enough to cause the facts to be forgotten, and the guides are consequently lost. This, however, cannot happen when the theory of an art is firmly based on scientific principles, and the reason of the phenomena is consequently understood; drawing our conclusions, from which we may say that the art of casting in bronze will henceforward never be lost, even should it be neglected for centuries; a few trials would be enough to bring it back to the point at which it had been left.

In the Middle Ages.

During the Lower Empire, nothing remarkable was executed except some bronze gates, and the process of casting seems to have been quite lost at Constantinople. The gates of the Basilica of St. Paul, at Rome, were cast in the 11th century by Staurachios Tychitos of the isle of Chios. In the 11th century were cast those of the basilica of St. Zeno, at Verona, on which are represented passages of the Old Testament and the miracles of the saint. The bronze gates of St. Mark, at Venice, were also brought from Constantinople in the 13th century.

Germany possesses some bronze gates of the 11th century, such as those of Mentz and Augsburg. In 1330, Andrea Ugolino executed two panels for gates in bronze, from the designs of Giotto, for the Baptistry of Florence. Ghiberti finished his chef d'œuvre in 1424. In the 15th and 16th centuries several gates of bronze were cast at Venice, Padua, Bologna, Florence, Pisa, Loretto, &c.; but these works were not sufficient to prevent the art of casting in bronze from falling

[illegible] B. 8. ch. 11. B. [illegible] B. 10. also Pliny B. 24. ch. 6.

* Pliny. B. 34. § 7. Suetonius says 120 feet.

into complete oblivion, and during almost the whole of the middle ages this art was wholly limited to casting bells.

In Modern Times.

At the Revival appeared several bronze works of art, in which Italian artists, and particularly those of the famous school of Florence, in the beginning of the 16th century, distinguished themselves most, and contributed most efficaciously in diffusing a taste for it in different European countries. The sculptor Torrigiani passed several years in England, where Henry VIII. gave him several commissions for bronze works. Primaticcio also executed, at Fontainebleau, several bronze statues from antique models which he had brought from Rome. At this time there were several French artists who were employed in brass founding; but their modes of proceeding seem to have been very imperfect, for Benvenuto Cellino relates in his memoirs that during his stay in France, he wished to cast a bronze statue of Jupiter about six feet high, which had been ordered of him by Francis I.; "but never having been engaged in this kind of work," said he, "I consulted some of the old masters of Paris, and explained to them how we managed in Italy. They replied that their manner was different, and that if I would leave it to them, they were sure to make my model in bronze such as it was in clay. I made my bargain with them; I promised them the price they asked, and even something over. I put my hand to work, but I could see well enough that they were not trying the right way. I wanted also to try myself upon a head of Julius Cæsar, larger than life, made after the model of a small head designed from a beautiful antique which I had brought from Rome. I added to it a head of the same size which I modelled from that of a beautiful girl in my service, and whom I called Fontainebleau, from the name of His Majesty's favourite palace. When I saw my furnaces finished, and our models baked, I said to my master founders, I fear that the Jupiter will not come out well, because you have not left draught enough for the air; but they replied that, if they did not succeed, they would give me my money back again, and that I should find less chance of success in the Italian method. This took place before some gentlemen whom the king often sent to see how I was getting on. Before casting the melted metal for the Jupiter, the founders wanted also to place my two heads to cast them at the same time, feeling persuaded that their mode would not succeed, and that it would be a pity to lose such fine works; but the king, who learnt it, sent to them to tell them that they must think of learning from their master, and not of teaching him. Then, smiling, they put their Jupiter in the pit, and I also arranged my two heads at the sides, and when the metal was ready, we left a free passage for it. Our moulds were quite filled, and we were all happy, I, with having succeeded in my way, and they in theirs. They asked me for something to drink, and I gave them plenty of refreshments; they then asked me to pay the sum I had promised them. You smile, said I to them, then, but I very much fear that you will cry soon; for I saw that more metal ran into the Jupiter than was wanted, and that is the reason that I shall not pay you until it is all right. These poor men felt that I was in the right, and went away without saying anything. They returned the next day very quietly to empty their pit, and began with the two heads, which were perfect; they then came to the Jupiter, which caused them to cry out, as I thought, for joy, and which made me run, but I found their faces like those of the soldiers who watched the tomb of Christ. You see, said I, what has happened to you from not believing me; you would have reaped more profit and I more honour. Learn, then, to work, and not to laugh at what is said to you. They acknowledged their error, but they regretted their time and expenses, on account of their families, whom they had to keep, and for which they should be obliged to run into debt. Never mind that, said I, I will pay you as soon as the treasurer pays me; for I pitied them, because they had worked with a good heart." Further on, telling the story about his statue of Perseus, which was also cast in bronze, he says, "The model of the Medusa, made of clay, and well-secured with iron, had already passed through the fire; I had already covered it with wax, and the bronze only was wanting. I had my furnace built directly; I took such good care, and the figure came out so clean, that my friends thought it was all done, like the French and German founders, who never finish their bronzes after they come out of the fire, being doubtless ignorant of the practice of the ancients, and many of the moderns, who finish off with a hammer and chisel." This remark of Benvenuto would lead us into the belief that the French and German bronzes contained a good deal of tin; for when the bronze contains a good deal of copper, its fusion requires a very high temperature, which vitrifies part of the sand of the mould, which, becoming attached to the figure in cooling, requires to be removed; on the other hand, a larger proportion of tin making the metal more fusible, this result was less to be feared. Benvenuto, not contented with having executed so many admirable works, left also a treatise on casting in bronze, which was long the best manual on the subject.

(To be continued.)

ON THE POWER OF THE SCREW.

Sir—There is an article by Mr. Cussen on the above subject in your number for May, on which allow me to make the following remarks.

His first objection to Mr. Bridge's formula seems to arise from a want of acquaintance with the style of mechanical language. Surely Mr. B. just meant by d, the pitch, or distance between the centres of the threads, or, in general, the distance between the threads, just as we talk of the length of an engine beam, when we mean its length between the end centres. Why did we not get an example from Bridges, to test his meaning of the ambiguous d?

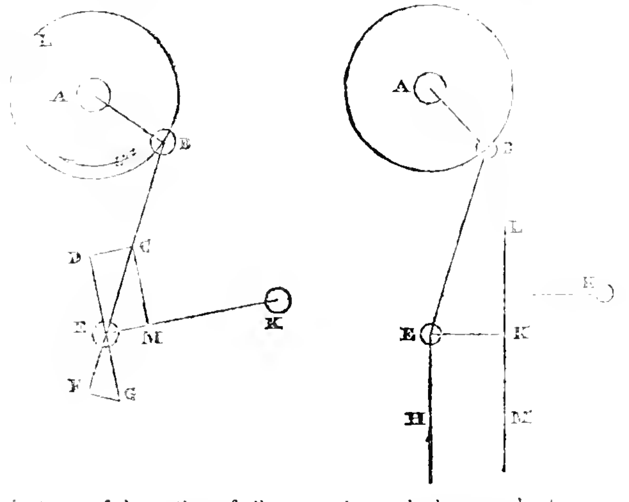
As to his second objection, he denies that the diameter of the cylinder is of no importance. One of 12 inches diameter, he says, will sustain six times the weight with the same power that one of 2 inches will do. Now this is not the point at issue. We are not talking about mere pressure, but of moving power. Let him consider that when the machine is set in motion, the velocity of the weight up the inclined plane increases as the diameter of the cylinder. Thus his advantage is neutralized by necessitating a greater velocity. But again, it is evident that with the same power at the same leverage, whatever be the diameter of cylinder, the weight that can be raised through the *same height* in one revolution must be the same. It is an established law that the momenta of power and weight are equal; therefore the momentum of the power, (viz. the product of its intensity by its velocity) being constant, that of the weight must also be constant; *i. e.* since the velocity of the weight is constant, (as it is raised through the same height each revolution,) therefore the intensity of the weight also is constant, and this inference is quite independent of the size of cylinder.

His third objection demonstrates that he has not thought three times on what he says. He confounds the *moment* of power with its *momentum*; a vital error. The moment of power is its intensity into its leverage, but its momentum is its intensity into its velocity. Now the relative velocities of the power and weight are the spaces passed through by each in one revolution; therefore the velocity of the latter is the pitch of the screw, and that of the former just the circumference of the circle described by its leverage. Therefore this element is chosen correctly in Bridge's formula.

ON LONG AND SHORT CONNECTING RODS.

Observing that there exists a controversy respecting long and short connecting rods, allow me to present the following demonstration of

Fig. 1. Fig. 2.



the justness of the action of all connecting rods, long or short.

Let $k\,e$ fig. 1, be the crank end of a side lever of a marine engine, $e\,b$ the connecting rod, and $a\,b$ the crank moving as per arrow in the circle $b\,l$. The resistance at b acts always in the line of the connecting rod; let $e\,c$ represent it in direction and intensity, just when the slightest overplus of power would set the engine in motion. The power acts always in the line $g\,e\,d$ perpendicular to $k\,e$; complete the parallel-equivalent of *ae d* and *be* are equivalent to *e c*, and these three forces are in equilibrium. Therefore, *ec* being the resistance, *be* is the power, and ... *e m*, the pressure on the centre *c*, which, as it never has motion, is of no consequence. Taking any point *f* in *be* produced, draw *fe* perpendicular to it, meeting *eg* in *g*; *ef* and *eg* will express the relative virtual velocities of the resistance and power respectively, and *fg*, the passive *lateral* motion of the line of resistance,—passive, I say, for its direction is at right angles to this, and it is therefore of no consequence. But the triangles *feg*, *dec*, are similar, therefore $de : ec :: fe : eg$, and $de \cdot eg = fe \cdot ec$, that is, the momenta of the power and resistance are equal. The same conclusion is due at every other point in the circle *b l*. An addition to the power will set the engine in motion, which would be uniformly accelerated were it not that the resistance increases with the velocity. However great, then, the power may be, there will ultimately obtain a uniform motion, when the power and resistance will be in equilibrium, their momenta being equal, as before. Therefore in connecting rod motion, force for force is given and received, and there is no loss essential to that motion.

The point *e* of *ke* moves alternately in a circle. The greater limit of this angular vibration is a semicircle, in which case $ke = ab$. The smaller limit is a straight line • an indefinitely small portion of a circle, its radius *ke*, being indefinitely long. This limit is practically exemplified in engines in which the piston rod is at once jointed to the connecting rod, as in the annexed sketch, fig. 2, of this motion, in which *a b*, and *be* are the same as in last figure; *e k* the cross head, bearing perpendicularly on the slide surface *l m*, parallel to the piston rod *he*, evidently in the same way as if bearing round a centre *k*, infinitely distant.

Upon the whole, then, short and long connecting rods on the same length of crank must be equally effective, whatever peculiarities there be.

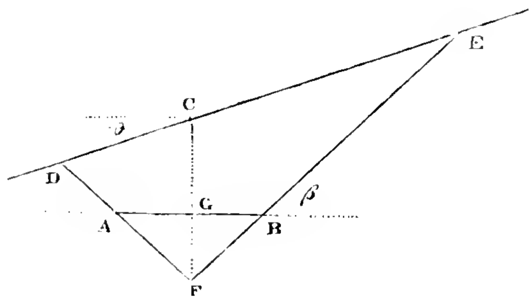
I am, Sir, your obedient servant,

Daniel Clark.

Phœnix Iron Works, Glasgow,
June 8, 1841.

SLOPES IN SIDELONG GROUND.

Sir—The following formula for "setting out slopes in sidelong ground," requiring the distances to be measured along the ground, and not horizontally, has, for that reason (particularly where the ground is very steep), an advantage over the formula in your last number; should you agree with me in this opinion, you will perhaps find a place for it in your next Journal.



Let $2w$ = width of the railway = AB.

$\beta = \angle$ of the slopes.

$\theta = \angle$ of the natural ground.

h = depth of cutting = CG.

Then $(w \tan \beta + F \angle) = CF$.

$$CD = (w \tan \beta + h) \frac{\sin CFD}{\sin CEF} = (w \tan \beta + h) \frac{\cos \beta}{\sin (\beta + \theta)}$$

$$CE = (w \tan \beta + h) \frac{\sin CFD}{\sin CDF} = (w \tan \beta + h) \frac{\cos \beta}{\sin (\beta - \theta)}$$

The slopes remaining constant then $w \tan \beta$ will be constant, and therefore the angle CDF will also be constant.

I am, Sir, your's most obediently,

W. R.

Manchester, June 8, 1841.

THE NELSON COLUMN.

Sir—As the Nelson column rises to view, we become sensible of what appears to be a great mistake in the *position* of it, and which ought to have been in a line drawn from the centre of the portico of the National Gallery through the Statue of Charles I., which appears as it ought to do in the centre of Whitehall; whereas the column seen from the same spot, will appear considerably to the right of the statue, and will be engaged with Drummond's Bank, the Admiralty, &c., instead of appearing to rise in the centre of the street, and thus producing a most awkward effect, whether as seen from the centre of the portico, or in approaching it as you come from Whitehall. This might easily have been avoided by placing the column in a line with the statue, which line, though not *quite* perpendicular to the plane of the portico, would have deviated from it in so very slight a degree as not to be perceptible to the eye, while the present position will produce an effect so glaringly awkward as at once to strike every beholder.—The mistake of the architect consists in having thought it necessary to place the column in a line perpendicular to the plane of the portico, whereas his object should have been to make the column appear to rise in the centre of the street, as seen from the portico which could have been done by the very slight and imperceptible deviation from the perpendicular above mentioned.

I am, Sir, your's,

Æsthetics.

ON THE THEORY OF BARS.

"Lorsque l'homme s'ecarte de la vraie cause d'un objet quelconque, il doit se considerer dans les tenebres, et il est forcé de chercher des arguments absurdes, dans lesque's il se perd, ce qui fait que les sciences deviennent ridicules dans l'opinion du vulgaire."—*Cuvier on marine deposits.*

Sir—Pursuant to the notice I gave in the last number of your valuable Journal, I take leave to send you for insertion the following observations on a "New Theory of Bars, &c., by Mr. Brooks."

The importance of the subject to this great naval and nautical nation, and to the maritime commerce of the world, should admonish us to pursue the investigation of this matter with the most cautious and serious consideration, for as it is well observed in the quotation at the head of Mr. Brooks' treatise, "our errors in this matter are of more importance than in mere objects of taste, luxury, or pleasure, because they will ever result in injury, or in the loss of some previous advantage." Let us also bear in mind Cuvier's reproof quoted above.

It does not appear requisite that I should refer to the many theories quoted by Mr. B., the controversy so prevalent at present, and in past times, in the scientific world on the subject of bars, demonstrates that it has not received that attention and examination which can lead to a right conclusion as to their cause, and what are the most eligible means to obviate the many evils incident to their existence; but I do presume that my subsequent remarks, based on facts and practical observations, will prove, that if the desideratum has not previously been developed, Mr B. has not reflected any new light on a subject hitherto by many supposed to be enveloped in darkness.

It appears apposite to notice that Major Rennel, quoted by Mr. B., p. 1 and 2, states, "that mud and sand suspended in the waters," (*i.e.* the egress waters) "during their motion are deposited when that motion ceases, or rather they are gradually deposited as the current slackens, according to the gravity of the substance suspended;" aod the late Mr. Telford gave a similar exposition. I did not expect in this age of the world, any one would reject such an evident and irrefutable fact, a principle ever in operation during the discharge of the egress tides, or currents; but Mr. B. p. 4, says, "I venture to submit, that it is insufficient," (*i. e.* the Major's thesis) "to account for the formation of bars, because the operation described (the deposit), as producing the latter (the bar), takes place in all rivers, in a greater or lesser degree, and in those which although their waters are abundantly loaded with sand or mud, are nevertheless free from bar." Mr. B. therefore disputes the accuracy of the Major's deduction, because it is the result of a partial, and not of a general law; why, Mr. B. has endeavoured to rest his entire case on local and partial data, and neglected to observe general principles.

That all rivers, harbours, bays, estuaries, &c., where the waters pass with a velocity sufficient to hold matter in suspension, have *beds* of sand, &c., is quite correct; but where the receding waters do not return or run out into the ocean with a force adequate to disturb the deposit that occurred during the quiescent state of the waters, as described by Major Rennel, there certainly *no bar or exterior accumula-*

tion can take place; for matter does not move without an impetus. Mr. B. then *de facto*, leaves the Major's thesis (with which I agree), where he found it, based on the solid and immoveable foundation of truth.

It is quite obvious that the Major has adopted the thesis that I have, viz.

1st. That wherever rivers, sluicing, or backwaters disembogue into the ocean, either under a natural or artificial impetus, and run with sufficient velocity to hold matter in suspension, and cause a conflicting action with the waters into which they pass, there a bar is formed.

2nd. That wherever there is an absence of egress waters, currents, tides or sluicing power, and where no conflicting action ensues, there no bar exists.

3rd. That to these rules there are no exceptions throughout the world, for wherever nature is placed under similar circumstances, she is immutable in her results.

> "Here then we fix the universal cause,
> God acts by general, not by partial laws."

These primordial, universal, and indisputable facts are deduced from an extensive field of observation of many years, and on various harbours, rivers, &c., during which time I have visited the Baltic, Gulf of Finland and Bothnia, Russia, Prussia, Denmark, Sweden, Norway, Jutland, Friesland, Holland, Belgium, France, Spain, Portugal, the Mediterranean, Africa's shores, and many harbours of the united kingdom,—but all this devotion has been dealt with by Mr. Brooks in a most summary way, and to refute my theory he has used the following words, page 5, chap. 6, viz.:—"That the casual direction of the lower reach, or the position of the mouth of the river cannot truly be assigned as the cause of the existence of a bar, is easily proved by observation on rivers subject to great variations at the entrance, the bar being always found to exist independent of the direction of the discharge into the sea, this fact at once refutes the third and fourth theories."—In this extract there seems to be two distinct facts, *i. e.* the casual direction of the lower reach, and the independence of a bar, in the direction of the discharged waters, that is, he means that the deposit or bar, does not occur in the direction or course of the egress waters. With respect to Mr. B.'s assertion of the independence of the bar, of the egress waters, I have much to say, if he be correct, he has indeed "at once refuted my theory," and would prove it to be a mere visionary and hypothetical deduction; but I will proceed to show the converse, and that he has committed, as in other parts of his book, an egregious error. If the reader will turn to the author's theory, subsequently here inserted, where he uses the *wedge* to aid his illustration, and where the battle with the elements occurs at the first quarter flood, he will find it stated, "that in the conflict the sand, or other materials, which it was (*i. e.* the effluent waters), capable of holding in suspension previously to its encountering the conflicting action of the flood tide, yields it to the latter, and when this takes place the *bar is formed;*" now observe, Mr. B. tells us that the material which drops and forms the bar, is brought down into the ocean by the egress or effluent waters, that as it advances onwards, (in its own direction of course), it encounters the flood tide, and where it meets that tide there the bar is formed; so that Mr. B. himself destroys the premises which he had the boldness to adopt for the annihilation of my thesis. The positive and irresistable fact is, that all bars are formed in the direction of the effluent waters, the latter are the impetus to the matter held in suspension, and that matter must fall in the direction of the impelling power, as a shot from a gun, the ball from the foot, or the deposit from the stream of the milldam.

Passing on towards Mr. B.'s theory, I notice in chap. 2, page 19, "pier harbours which though free from bar in their natural state, are well known to become encumbered by them, on the introduction of the scouring power," here I suspect he cast his eye southward on Lowestoft Piers. Scouring power no doubt (this is my principle), causes a bar, no matter whatever way or manner it is conducted to the sea, naturally or artificially, whether there be piers or no piers.

The commencement of chapter 11 is a mere repetition of my second proposition, "That whenever a river or harbour approximates to the condition of a simple inlet for the reception of the tide it would have no bar." I endeavoured some time ago, in a conversation with Mr. B., to illustrate this truism by a reference to various harbours where the water did not pass into the sea, with a sufficient velocity to disturb the bed, there no exterior deposit could take place; no matter whether such a harbour be naturally or artificially constructed. Norway, Scotland, Ireland, Scilly Islands, Minorca, and Malta harbours, are of the first kind; Ramsgate, Margate, Scarboro', Cronstadt, Elsinore, &c., the latter.

In page 13, Mr. B. in noticing the geological features of the Yorkshire coast, says, "That a residence of some years on its shores, and a close observation enables him to state, that those seas that break on the outward platform, (the outer flat) are much heavier than those which break nearer the shore." I bear testimony to the accuracy of this fact, taught me in my boyish days by the boatmen, sailors and fishermen, that on all flat shores, or in different elevated platforms (if they must be so designated), the sea loses its force, where it is first intercepted by the shore, and as it advances and rolls up the inclined plane, so the concave dimension diminishes, till at last it finishes in a mere ripple, or tiny billow.

I have now arrived at our author's theory, and it is *multum in parvo.* "During the period of the first quarter flood, the current, in lieu of being able to take its natural upward course, as in rivers where *no bar exists*, is opposed, or effectually checked, by the effluent backwaters; the declination of the stream in the lowest division of the river presenting a head which ensures a strong downward current, long after the tide would have been able to maintain an upward course, provided the backwater had a free discharge; at this period the flood tide, by reason of its greater specific gravity, occupies the lower stratum of the tide-way, and like a wedge endeavours to force its course up the channel, which it is unable to effect, but merely elevates the lighter effluent water, the lower strata of which, being checked by the opposition of the tidal waters, yields to the latter the sand or other materials which it was capable of holding in suspension, previously to its encountering the conflicting action of the flood tide; where this takes place the bar is formed."

Having shown that Mr. B. has attempted to refute my thesis by the aid of a fallacious assertion, I now proceed to prove that he has based his own on a sandy foundation. He commences this part of his work by stating that the current, in the first quarter flood, is not able to take its natural course upwards, as in rivers where no bar exists—that is, where a bar does exist it is not able—and that this inability is occasioned by the conflicting action of the waters (and which conflicting action only exists where a bar is already formed,) and where this takes place (the conflicting action), there the bar is formed. So that, in order to sustain his "novel theory" on the cause of bars, he first must have a bar to produce the cause of a bar, and thus the effect produces the cause, and with this mode of reasoning, illogical as it is, he has attempted "at once," and with one fell swoop, *nolens volens,* to throw me overboard, and include in his general sweep, all who have attempted by principle or practice, ancient and modern, a development of the cause of bars. Mr. Brooks requires a backwater falling out of a sloping river, and that water to be opposed by a first quarter flood, and a bar itself to produce a bar; he appears not to be aware that in various parts of the world bars have accumulated where there is an entire absence of his causes, and not only at places "which approximate to the condition of a simple inlet," but where the only existing cause, amongst those which he assigns for a bar, is the egress or scouring waters; examples of which we have in the Baltic, the Black, and other seas.

In my examination before a Committee of the House of Commons in 1826-1827, on the proposed Lowestoft Harbour, I then stated "that so soon as the scouring water should be applied as then proposed, a bar would accumulate where no deposit or bar previously existed, and if the sluicing were continued the harbour would be so blocked up that small vessels only could enter at high tide." He need only refer, to prove the accuracy of his prescience, to the present state of the bar at that harbour, and the fact that about £150,000 have been expended thereon, the entire of which has been recently offered for sale by the Loan Commissioners for £17,000, it being completely lost as a harbour of refuge for which it was intended."

It is an incontrovertible fact, that the greater the quantity of egress, or sluicing waters, and the more rapid their course, the greater is the exterior deposit. The Mississippi and other large rivers demonstrate this fact—the entrance to that queen of rivers is most difficult in the spring of the year, when the melting of the snow on the mountains increases the quantity and rapidity of the egress waters, so as to carry with them trees, earth, and other matter, all of which are deposited on the extensive bar, at its outlet, and it does not again decrease until after a long continuous dry season, when the quantity of egress water is reduced.

Mr. B. follows his "new theory" by stating, "that he might easily extend his illustrations," and adds that the "direct tendency of the whole period of the ebb, when unobstructed by the tidal currents, must be to reduce the bar." This is really hypothetical. That the ebb or outgoing waters have a direct tendency, and are the real cause of all exterior deposits or bars, &c., I have asserted for the last 20 years, the accuracy of which I will now attempt to prove. At the Neva, Gulf of Finland, the Narva, Dantzic, the Danube, the Nile, and many other places, the current, without intermission (there being no *flood tide*), is perpetually running out at the rate of six, seven, or eight knots per hour, and yet the old entrances to those rivers have been blocked up by impassable bars, and either new passages have been cut into the ocean, or the egress waters have forced a passage out in a new direction; here we have an absence of quarter flood, sloping, and of the difference in the gravity of the two waters, no salt water being in the vicinity of the disemboguing site of the above rivers.

I must now take leave to make an observation on Mr. B.'s proposition to take away the shoals or deposits in the Thames, at Woolwich by scouring, and not by dredging, the result of such an operation (if it were accomplished) would be, that the matter moved could only be impelled onward while the impetus was retained, but so soon as that ceased, a re-deposit would occur which would occupy the same extent of the bed of the river, which it had previously done—he seems not to be informed of the effect produced on Barking Shelf, removed by dredging although an immense accumulation of sand and shingle, the base of which appeared at low water—but I will not further interfere with the interior part of his subject, that is all plain sailing, no insurmountable difficulty occurs in attempts to improve inland navigation, there we have no impinging billow, or any material effect produced by the winds or tides.

Before I conclude, allow me to give some farther proofs of the accuracy of my two first propositions—New Zealand, "The entrance to the bay at Wangarver is 11 miles broad, perfectly safe, and without a bar; the bay is studded with rocks, (so are the harbours I have previously referred to as being free from bar). The water is deep close to the shore. The bays of Plenby and Port Nicholson are similarly formed and are free of bar, although no back waters. The harbour of Hokianga with an extensive interior river, where the waters run out at every ebb tide, there a bar exists. In the West Indies, at St. Lucia and the Havannah, both splendid harbours, but have neither rivers, back waters, nor bars.

I remain, Sir, your obedient servant,

Henry Barrett.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXVIII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. The absurd trifling, the stupid pedantry, the puerile discussions that at one time engaged the attention of architects, almost surpass belief, and are to be paralleled only by the quibblings of the schoolmen and divines of the dark ages, when theology was reduced to idle disputation, and religion to the practice of the grossest superstition. Were it not so authentically recorded, that it is impossible to doubt the fact, hardly would it be now believed that the problem proposed by Sansovino as to the mode of obtaining the *exact half* of a metope at the angle of a Doric entablature—the *semimetopia* of Vitruvius—made a noise throughout Italy, and excited the attention of all the architectural geniusses of the time! Had Sansovino and his contemporaries been equally scrupulous and precise in all other matters, we might excuse their overniceness in regard to such *difficiles nugæ;* instead of which they were most latitudinarian, even shamefully so in many respects. Like those people who make no difficulty of jumping over mountains, yet break their shins against straws, who can swallow millstones whole, yet are choked by a pound of butter, they were not at all shocked at some of the grossest violations of architectural propriety. In some of Sanmicheli's plans, for instance, the rooms are so frightfully out of square, that no two sides are parallel to each other. Symmetry, too, in respect to the position of doors and windows within buildings, is totally disregarded, as if it were perfectly indifferent whether it were attended to or not. The designs of Il Divino Palladio, as he has sometimes been called, abound with scandalous defects of this kind. I suspect that his "*divinity*" must have been somewhat of a piece with that of Il Divino Aretino, a monster who ought to have been hanged, drawn, and quartered. Such "divinities" as the last must be inquired for in the infernal regions.

II. Nothing can be more opposed to every legitimate principle of art and æsthetics, than the attempt to reduce the different orders to so many express and immutably fixed types. The consistency so aimed at is attended with almost the worst species of inconsistency, because it totally excludes such modification as may be most suitable for the particular case. It is time for us to get rid of all the mechanical quackery to which we have so long submitted, and which has reduced architecture, as generally practised, to little better than a mere handicraft trade—to copying certain individual parts met with in former styles of the art, without any regard either to the genius of the styles themselves, or to the circumstances of the building required. What puerile trifling it is to affect scrupulous nicety as to the express shape and proportion of every little detail belonging to columns which are to be stuck up by way of portico before a dowdy house or other building, which is thereby only rendered a grotesque absurdity! In most other matters people think of attending a little to consistency and common sense; or should they fail to do so, they must submit to the derision of their neighbours. But in architecture, the most ridiculous incongruities and *disparates* are tolerated—tolerated! they are even applauded: and *bêtises* that would hardly be endured in the preparations for a temporary fête, may be perpetrated with impunity in buildings intended to be permanent.

III. "Geniality" is not an English word,—hardly can it be said to be as yet adopted by us; and what is more to be regretted, there is, I apprehend, very little of the thing itself among the artists of this country. At all events very little evidence of it is to be discerned in our architecture. Looking at the majority of the buildings which have been erected of late years—and they certainly have not been few in number, they must be allowed to confirm such opinion, disagreeable and unflattering as it is in itself. If we find the styles respectively aimed at, copied with passable fidelity, without any particularly gross violation of their principles, it is nearly the utmost that can be said in their favour; and as matters stand, such poor negative merit must be received as a positive one. How very far, however, it stops short of geniality, hardly needs to be said, it being sufficient to remark that the latter draws out, concentrates, and heightens all the good qualities of a style, and at the same time imparts to them some fresh charm, some additional unborrowed value: and that, even though the subject should be an unpromising or inconsiderable one in itself. If he cannot always create favourable opportunities, a man of real talent will, at least, do the very utmost that circumstances will permit—will convince us that he has not satisfied himself with merely turning out a decent, workman-like job, but has applied himself to his task as to a labour of love, with the feeling of an artist, not of a builder—not of a tradesman. Were we to believe some of those who, albeit without aught of the artist in their constitution, style themselves architects, their genius would blaze forth upon the world, were but sufficient opportunities afforded them. The man who cannot put together two ideas—except detestable ones—for a moderate-sized house, or church, would be able, nevertheless—if we choose to believe him—to erect the most splendid palatial and ecclesiastical edifices. John Nash was an architect of this stamp, and as it most unfortunately happened, opportunities, both many and of no ordinary kind, were thrown in his way. How he acquitted himself of them is but too well known. It is to no purpose that Theodore Hook affects to consider him the victim of harsh and illiberal criticism; or that *Professor* Brown, as he facetiously designates himself, tells us, *ex cathedrâ*, I suppose, that John was "a man possessing great taste for the grand and the picturesque." For the Grand! Surely the learned Professor must be speaking sneeringly and ironically, for never did Nash, on any one occasion, even approximate to the grand or the dignified in architecture. Never did he get nearer to it than 170 degrees E. or W. longitude of it. Still, incredible as it may appear, the enlightened Professor is not joking, but intends it to be taken as his serious opinion; for he elsewhere speaks of "the magnificent houses along the Strand, King William Street, and the splendid houses in the Bayswater Road!!" adding, "but when we behold the more magnificent columnar edifices on the east side of the Regent's Park, and the crescent on the west, where the houses are crowned with octagonal domes, we stand astonished with admiration!!" Most undoubtedly we do so, Mr. Professor Brown, for we stand absolutely "putrified" with astonishment that such masses of ugliness and vulgarity should ever have been erected. However, perhaps the Professor judges of Nash by his own quantum and calibre of talent and taste, in which case he has undoubtedly sufficient cause to look upon Nash as a very great man, he himself being but a mere dwarf and pigmy by the side of him, as his own designs abundantly testify. When we look upon those architectural abominations and atrocities, we do indeed stand astonished, but it is with the astonishment of unmitigated horror and disgust. Oh, Professor Brown, Professor Brown, unlucky was the day and hour when you dubbed yourself with that ambitious title. Could you get rid of it again—but no, that is impossible; it will stick to you for ever; it will render you the laughing-stock and the byword of the profession. You cannot *un-Professor* yourself now, or divorce yourself from the ill-sorted companion to which you have married your name. Doctors' Commons won't help you, Dr. Lardner will not run away with that "better-half" of you. Professor Brown you have made yourself, and Professor Brown you must now continue to be in spite of yourself. You cannot metamorphose back again into plain Dick Brown. I pity you, I compassionate you, I condole with you—yet infinitely more do I pity and compassionate those unfortunate devils who shall imbibe their architectural taste from the designs of Professor Brown!

ARCHITECTURAL ROOM, ROYAL ACADEMY.

(Concluded from page 181.)

Having made a month's pause, we will avail ourselves of it, before we resume our own comments, to express our astonishment at an opinion we have in the interval met with, in regard to the architectural portion of the Exhibition. Either we, or the writer in the Mirror, is egregiously mistaken, for he tells his readers that the designs for new churches and other public buildings are "very numerous and in good taste;" whereas we think that there are rather fewer of the kind than usual, and those for the most part of very mediocre quality. In fact, it is only by referring to the catalogue and our own notes, that we can recollect above one or two, so little is there at all striking in them—except, indeed, it be by making an unfavourable impression. Such, certainly, is the case with respect to one, which is singled out by the writer in the Mirror, viz. 1059, "The Estate building at Hackney for J. B. Nichols, Esq." by J. A. Taylor, which consists only of a crowd of ugly houses detached from each other, but all *dittos*, instead of being varied as to design,—no doubt a laudable idea enough, because it saves the architect a great deal of *trouble*, without, perhaps, at all diminishing his per centage. Such architecture may do very well for the latitude of Hackney, but it is not fit to be paraded upon the walls of a Royal Academy. Or if such things must be exhibited, they must also take their chance of being somewhat cavalierly treated, since it is not every one who is so complaisant as the critic in the Mirror—a mirror, by the bye, which flatters most confoundedly.

Some may think that the Mirror's opinions are scarcely worth noticing at all, since, instead of being put into positive and tangible shape, its criticism amounts to little more than quoting from the catalogue the titles of such designs as it would recommend, and have us understand to be meritorious, without our being so unreasonable as to ask for reasons. The Art-Union—from which something better might be expected—deals in nearly the same sort of criticism, being exceedingly laconic and oracular, or, we might say, that one had need consult an oracle in order to understand upon what grounds it mentions for approbation some of the things it does—for instance, "No. 1033, Design for an Opera House, by J. C. Tinckler." We confess that that subject struck ourselves, but certainly not with admiration, the taste displayed in it, seeming to us in some respects absolutely barbarous, and what was not positively barbarous, to be no more than barely endurable. Far more readily do we agree with the Art-Union when it says, "the churches now being erected through the country, such as that at Nuneaton by Mr. T. L. Walker, seem, thanks to the Church Commissioners, to be designed by the dozen, with no better recommendation than cheapness, and no other better point about them than the certainty that they cannot last many years." As to the quality of the design thus referred to, we ourselves cannot pretend to offer an opinion, because that and about half a dozen others of the earlier numbers in the architectural section of the catalogue, are put out of sight, perhaps very deservedly so, for there certainly is nothing at all prepossessing in what can now be distinguished of them—nothing to make us particularly anxious to become more intimately acquainted with them. That a Royal Academy, not bearing the title of an Hibernian one, should persist, year after year, and in spite of repeated remonstrances, in adhering to the blundering practice of *exhibiting* drawings by hanging them where so many frames and blank paper would cover the walls—if covered they must be—quite as well, is nothing short of marvellous. If no remedy can be devised, it would at all events be but becoming and proper that the highest and tip top places should be assigned to the works of the Professor and other Academician architects; let them be exalted, and there is no doubt that they would instantly perceive and correct what they now cannot discern, viz. the gross absurdity of admitting more drawings than can be properly seen when hung up. We certainly meet with a good many whose absence would have been no loss to the exhibition; and the very first upon the list, viz. No. 956, "View of Hyde Park Gardens, Paddington," is among them, it being a subject we are sorry to see either in reality or representation—a heavy mass of bloated insignificance. No. 980, "Lonsdale Square, Islington," R. C. Carpenter, is another "flare-up" concern of the same kind. The houses that are shown may be passable enough as dwelling-houses, but as architecture they have no pretensions, nor has a drawing of this class much claim to be admitted into an academical exhibition. There are one or two designs for the Taylor and Randolph Buildings at Oxford, and we may mention that by Messrs. Mair and Browne (No. 966), as being entitled to considerable praise—as much better, in fact, than any of those for the same edifice which were exhibited last year: and it is stated to have been one of the five selected in the first instance by the committee. We should have examined it more attentively than we did at the time, had we then known as much as we now do of the design which has been adopted. We need not inform our readers that this last is by Mr. Cockerell, the Professor of architecture; but we may assure them it is by several degrees more fantastical and outré than his design for the Royal Exchange, and in some respects perfectly nondescript as to style. How the Professor—who seems ambitious of obtaining for himself the title of the English Borromini—can reconcile the *extravaganzas* he has there shown, with the precepts he delivers *ex cathedrâ*, cautioning the students against aiming at mere showy effects, rather than architectural propriety, it puzzles us to guess;—and it would, no doubt, puzzle him still more to explain.

Messrs. Gough and Roumieu's design for "St. Pancras' National Schools," (No. 976) is a small but pleasing composition, in the Tudor style, with a rather unusual degree of decoration, therefore should the building itself turn out to be as satisfactory as the drawing represents it,—which, however, is not invariably the case, it will be nearly the best thing of its kind in the metropolis. No. 1096, "Interior of the new Library at Roehampton Priory," by the same architects, is also sufficiently creditable to them; but they must excuse us for not admiring that for "St. James' Dormitory Chambers, as proposed to be erected" (No. 1080)—yet, we hope, as never will be erected. Were it not too late, we should enter a similar protest against No. 977, "An Elizabethan Villa, now building at Hammersmith, from the designs of Mr. S. Gomme," for it is a most Gommy or '*gummy*' affair, as a friend of ours would call it,—a specimen of all that is most hideous and barbarous in that style, without any of its redeeming qualities; and it would seem that the architect's aim had been rather to exaggerate than to mitigate any of its deformities. It may be excusable enough in the possessor of a genuine relique of Elizabethan architecture to be somewhat jealously proud of it—for its antiquity if for nothing else; but that at the present day any one should think of building for his own habitation a 'bran new' absurdity of the kind we here behold, is to us most marvellous.

No. 982, "New Park near Devizes, showing the principal front, with alterations and new carriage entrance," does not impress us with any very high idea of the taste or ability of Messrs. Finden and Green. How far they have doctored up the house, we know not: for aught we can tell they may have improved it, but if they have it must have been deplorably bad indeed before, since it is bad enough—we should say, intolerably bad even now.

Though we wish there were a far greater proportion of interior views than we ever meet with among the architectural drawings, we could very well have spared one of those which Mr. T. L. Walker has sent, of the "Governor's Dining Room at the new Hospital, Bedworth, Warwickshire," viz. Nos. 1014 and 1088, they being nearly duplicates, showing opposite ends of the same apartments, which although very fair as to design, is not so remarkable as to call for such an unusual degree of illustration; and we almost wonder that two drawings of the same subject should have been admitted, when others were turned away for want of room; or that, as both were received, they were not hung up together as companions. It appears, moreover, to us that either the perspective is very faulty, or else the windows themselves poor in character, owing to the excessive breadth between the mullions, according to the drawing.

No. 1027, "View of the London and Brighton Railway Terminus, now erecting at Brighton, from the designs of" D. Mocatta, is exceedingly poor both as a drawing and a design; and we are afraid he cannot shelter himself under the excuse that the subject was an unfavourable one in itself, or that he was cramped in his resources; because there is certainly enough of it as to extent, and the same degree of decoration might have been far more effectively applied. The extended colonnade below is in itself appropriate and convenient enough, but as it is made to project from the loftier mass behind it, it seems rather to encumber than to ornament it; neither is it by any means unexceptionable in regard to design. We are very far from objecting 'upon principle,' to arches being turned upon columns: on the contrary, we consider some of the instances of such combination to be among the happiest effects of Italian architecture. What we complain of is, not that such mode is here adopted, but that it is treated most insipidly, and that want of artistical feeling pervades the whole design.

At first sight we mistook No. 1056, for a view of the Parthenon or some other Grecian Doric temple, but on referring to the catalogue discovered it to be "A project of a Curesal or Pump-room to be erected on St. Ann's Cliff, Buxton, with plans, elevations, and sections," by W. L. Granville; and there certainly are some miniature drawings on the margin, which may be the plans, &c., but which it is utterly impossible to make out at such a height above the eye; consequently all we can say is that, however ingeniously Mr. G. may have contrived the interior of his building he has not shown much invention, or particular propriety of character in the exterior of it.—We begin to get altogether sick of Grecian temples.

The "Façade of the Wesleyan Centenary Hall," No. 1058, is now exhibited as executed, the Lysicrates Monument, stuck upon it last year, being lopped off from it; which being the case we think that the frame might have been reduced also, for at present the drawing occupies twice the space the subject itself requires, and every square inch is or ought to be of value in this room.

No. 1065, "The Library, Northwood House," G. Mair, is a small interior subject that appears to deserve a more favourable situation than it has obtained. No. 1071, "Entrance Lodge to be built at Deane Park, the seat of the Earl of Cardigan," J. Crake—a name new to us—is also a clever design, in the Gothic style. We cannot say quite so much for No. 1110, "Design for a Gothic Roof in Guildhall, London," E. Woodthorpe, for though the drawing itself is a showy and elaborate interior, the new timber roof here proposed, is a poor and meagre affair. If, too, it is intended to make any alterations at all in that edifice, we think that the one most required, is to give it an entirely new exterior, the present one being so atrociously ugly that we wonder how even the corporation of London can stomach it. Taste they have,—at least have the reputation of possessing it, but it does not lie in architecture.—No. 1108, "Entrance front of a design for a Mansion to be erected at South Elkington, Lincolnshire," E. B. Lamb, is a good composition in what may be called the irregular or picturesque Italian villa style,—with a carriage porch and tower over it. While the offices are kept subordinate to the house itself, they are made to aid the general character very much, being treated consistently with it, and so as to give importance to the principal mass, and at the same time be of sufficient architectural importance in themselves. Both picturesque expression and propriety have been consulted, by introducing only a single ground floor window on this side of the body of the house: not only is great privacy thus secured, and the noise and bustle of horses and carriages shut out from the sitting rooms, but a degree of piquancy is imparted to the whole; the internal arrangement cannot be understood until we actually enter the house, which is not the case where there is a range of windows on each side of the entrance. And here we will bring our strictures to a conclusion, lest by continuing them we should be compelled to change our tone again, and have to speak not quite so favourably. Towards some our silence may be unbecoming, but there are a great many who have reason to congratulate themselves that we lay down our pen before we give them a touch of it. Very possibly we have passed over several drawings that we should have been able to notice with approbation, had they been hung where they could be seen; so long as the present system is persisted in, such is likely enough to be the case. That it is persisted in is no fault of ours: on the contrary, did it depend upon ourselves, we would correct it instanter,—if no other way, by cutting the formidable Gordian knot, and reducing the Five tiers of frames containing architectural drawings, now hung up, to Two. Three of them might very well be spared, for the quality of the Exhibition would be rather improved than not by their absence.

ON THE INJURIES TO HEALTH OCCASIONED BY BREATHING IMPURE AIR IN CLOSE APARTMENTS.

Notwithstanding the various inventions and improvements which distinguish the age we live in, it is lamentable to observe what little attention has been paid to the ventilation of apartments in which we are destined to pass the greater portion of our lives, and in which a constant and well-regulated supply of the element we breathe, is so essential to bodily health and mental enjoyment.

This inattention can only be accounted for either by the want of education in the major part of that class of persons who call themselves builders, or an apprehension on the part of those who aspire to the more elevated designation of architects, that the introduction of any thing new would expose them to the charge of a want of taste, or of that acquaintance with the style of the ancients to which it is the fashion so strictly to adhere (imitation being, in their opinions, more deserving of commendation than originality of design, or a desire to meet the improvements of the age, and fashion of more importance than health). If they construct our doors and windows in so superior a manner as to exclude every possible particle of air, they flatter themselves with having attained an advantage to which the inhabitants of ancient Greece and Rome did not aspire. They should, however recollect, in their apparent anxiety for imitation, that the ancient architects of warmer climates did not overlook the necessity of a free admission of air, and also that a constant supply and free circulation of this element, is as necessary for sustaining life as a given quantity for the combustion of the fuel we require to warm our apartments; our builders, nevertheless, only provide for the latter, as if the former, although the more important, was of minor consideration, or that they conceived the chimney draft sufficient for both purposes, when, in reality, it does not answer that for which it is principally intended—as by far the greater portion of the heat generated in our open fire-places is carried up the chimney, by sharp currents of air from occasional openings of doors, or such crevices as it may force its way through, being moreover, frequently productive of serious bodily injuries, particularly to those of delicate frames, while it cannot be sufficient for the purposes of wholesome ventilation; this air being colder than that already in the room, is consequently of greater specific gravity, and must form a lower stratum, not unfrequently felt by those placed round the fire, suffering from an undue proportion of heat at one side and of cold at the other.

It should also be borne in mind, that the openings of our fire-places being seldom more than three or four feet from the floor, the upper stratum of air is neither removed or purified by this under current, and must, from being breathed over and over again, be productive of most prejudicial effects, and that the contamination of this atmosphere is considerably augmented at night by the combustion of lights, the quantity of air breathed by an ordinary sized person being calculated to be about 2000 cubic feet per hour, and that two mould candles consume as much of the oxygen of this air as a human being, and that the nitrogen and carbonic acid gas which remain are peculiarly inimical to animal life, and that when carried up by the currents occasioned by combustion and respiration they form an upper stratum, where they remain, and must be repeatedly inspired before they make their escape into the chimney—the only ventilating flue with which our houses are provided.

It should also be observed, that the heat thus generated is in proportion to the quantity of oxygen abstracted from the atmosphere, which enters into combination with the carburetted hydrogen of the flame of candles, coal gas, oil or other inflammable matter, from which light is produced, that every cubic foot of carburetted hydrogen consumed unites on an average with two cubic feet of oxygen, that portion of the atmosphere required to support animal life, and that the product of this combustion is about 2½ inches of water, and one of carbonic acid gas, which, when inhaled in its pure state, proves instantly fatal, and the greater the proportion we inhale in addition to the animal vapours evolved from the lungs and skin, the more pernicious the effect.

Supposing for example that the perfect lighting of an ordinary sized apartment requires 15 cubic feet of carburetted hydrogen per hour, this would form about a pint and a half of water and 15 cubic feet of carbonic acid gas, for whenever carburetted hydrogen gas is burned with oxygen, or atmospheric air, these are the products of the combustion, whether the carburetted hydrogen is obtained from wax, tallow, oil, or coal. If, therefore, this lighting continue in an unventilated apartment for seven hours, one gallon of water is produced, the greater part of which must be deposited on the walls, windows, furniture, polished metal, or other cold surfaces with which it comes in contact, and to some articles of this nature it is known to prove highly prejudicial, in addition to the injury to health occasioned by an increased quantity of moisture mixed with the air we breathe—as one of the principal functions performed by this air for the preservation of health, is to carry off with it a considerable quantity of vapour in order to prevent its undue accumulation on the lungs; it is therefore evident, that after it has been already so loaded, it cannot properly perform these functions, and that consumption and other complaints are thus frequently induced.

The prejudicial effects of carbonic acid gas (which is the same as the choke damp of mines) as well as of the nitrogen of the air, which is set free by the abstraction of the oxygen, (and amounts in quantity to four times that of the oxygen,) are well known, and ought by all possible means to be provided against. This has been attended to within the last few years in our public hospitals, and the mortality, in consequence, considerably decreased, and likewise in several of our manufactories and public establishments, where the diseases generated, by the numbers of persons congregated in such establishments, have been proportionably diminished. In the House of Commons, also where hundreds of members with hundreds of candles burning at night tended so much to vitiate the atmosphere, important improvements in lighting as well as ventilation have been recently made, but in our domestic establishments little or no attention has been paid to this important subject, and the foundation of a variety of diseases must be the result, particularly from the foul air breathed at balls or other crowded assemblies.

The confinement of air in our churches and places of public worship, must also be highly prejudicial, as we are frequently exposed on entering one of these edifices in the summer months to an atmosphere 10° or 15° below that of the external air, independent of the stagnant state in which it has been allowed to remain during a whole week—often vitiated in a greater degree by the gaseous matter evolved from human remains, and even in private houses much inconvenience is experienced from the stagnant state of the atmosphere in close and gloomy weather, an evil which has been considerably augmented by close stoves, when made of iron and heated to a certain temperature.

But if stoves were constructed of masonry throughout, as in many other countries, or of fire tiles, or porcelain plates, embedded in mortar with well-regulated flues, they would be far preferable to open fire places, this substitution of imperfect conductors of heat being not only consistent with the soundest principles of economy in the preservation of heat, and its more uniform distribution through apartments, but more salubrious than the methods usually resorted to in this country of warming air by contact with iron stoves or pipes.

The healthy appearance of those who pass the greater part of their time in the open air sufficiently indicates its advantages; armies are also well known to have far greater numbers on the sick list when well housed, than when exposed in a campaign to the vicissitudes of the season, for weeks and months without any other covering than the canopy of heaven, or occasionally of a tent or hut, or the shade of a tree. These facts ought to satisfy us that we should admit the air as freely as possible into our apartments at all seasons of the year, as the temporary and often imaginary inconvenience of a little cold, when compared with the decided disadvantages of breathing impure air, is by far the lesser evil.

When ventilation in large establishments or public buildings can only be obtained by artificial means, it is produced by pumping air in, or drawing it out by a fan worked by steam or other adequate power, and affording it the means of free circulation either cooled, heated, or in its natural state, through well-regulated apertures in the floors, walls, or ceilings, and in coal mines by flues or shafts in which constant currents of air are maintained by the combustion of fuel or coal gas; this system might also be easily introduced into houses already built, by means of the existing chimneys; but with still greater facility if our architects and builders were to direct their attention to those points when erecting new ones.

The importance of this subject has been frequently pointed out by scientific men of considerable eminence, without attracting that attention which would have been the means of rescuing many persons from being imperceptibly hurried to an untimely end. It is, therefore, to be hoped that the powerful engine of the press will continue to lend its aid in exposing these evils, until it impresses upon the public mind, and more particularly upon our architects and builders, the urgent necessity of providing against them. Is it not possible, by some simple contrivance, to make the heat produced in the lighting of apartments available for their perfect ventilation? if any of these gentlemen succeed in so doing, they will be entitled to greater gratitude for this achievement in the purification of an element so essential to the preservation of our lives, than any claimed by those heroes whose victories have contributed so much to the miseries of the human race, and the destruction of the human species.

But we ought not, perhaps, to be so much surprised at the slow march of intellect in this respect, when we find so many centuries to have elapsed before it was so generally admitted, as at present, that pure water, another element bountifully supplied by nature, is preferable to any other beverage for insuring the health and happiness of mankind, and when we have so many temperance societies and other advocates for impressing upon the minds of our fellow subjects the necessity of becoming converts to the imbibing of this element in its pure state, ought we not, with still greater reason, to endeavour to make a similar impression as to the advantages of inhaling, with equal purity, the lighter fluid, of which we stand so much more in need, and which we so much more frequently require?

A gasometer of sheet iron formed of 269 pieces, and of an immense capacity, arrived at Antwerp on the 5th instant, by the *Soho* steamer from England, intended for the gas works in that town.

REPORT FROM THE SELECT COMMITTEE ON RAILWAYS.

Our readers are aware that the 11th clause of the Railways Bill, which was for the purpose of giving discretionary powers to the Board of Trade as to the regulation of railways, excited the greatest alarm on the part of the railway boards. Sir Robert Peel was consequently induced to move for a special committee to receive evidence as to the tendency of the proposed clause. This committee has now concluded its labours, and after a lengthened investigation has made its report. The committee after stating the arguments used on both sides, sum up by recommending that the Board of Trade should not at present have the discretionary power contemplated in the 11th clause of the Bill above quoted, and prefer that the supervision of that department should be exercised in the way of suggestion rather than in that of positive regulation. This, as it will be seen wards off the blow for another year, and we hope that the railway interest will be so far instructed by this attempt, as to take better measures to oppose any future aggression of the Board of Trade.

The evidence attached to the report contains much matter of interest to which we shall be obliged to refer in a discursive manner, but before we refer to this we feel it our duty to express the obligations which the profession owes to Brunel for the able and candid way in which he gave his evidence, throwing aside all personal considerations and feelings of partiality, uninfluenced by the blandishments of the Board of Trade, and not to be deceived by its sophistries, he boldly and unscrupulously stripped the railway department of its pretensions, and exposed the incompetency and ambition of its officers. We wish that it were in our power to give equal praise to the elder Stephenson, but with the exception of the noble tribute he gave to the merits of the Great Western railway, he presented a lamentable contrast to Brunel.—Mr. Labouchere exhibited an ability in the management of his cause, which we cannot but recognize, but we must at the same time regret that it was not exerted in a better cause.

From Mr. Laing's evidence and from the documents annexed we learn some particulars as to the constitution of the Railway Department of the Board of Trade, which as it is of some importance we have thought it desirable to notice. The Department is placed like the Statistical Department in charge of Mr. Porter, and for which he receives 200*l.* per annum extra, but it does not appear that he takes any very active part.—Lieutenant-Colonel Sir Frederic Smith is Inspector General of Railways, with a salary of 900*l.* per annum and travelling expenses while engaged out of London, but without retiring allowance. The Board of Trade observes that, "the provision of the act which excludes the appointment of any one connected with railways, and the high rate of remuneration, which would be requisite to secure the undivided services of any eminent civil engineer, are of themselves sufficient to direct and almost to restrict their Lordship's choice to some officer of the Royal Engineer corps, who has a competent practical knowledge of railways." Mr. Laing transacts the official business of the Department, and is the Law and Corresponding Clerk with a salary of 500*l.* per annum.—Mr. Porter and Mr. Laing are authorized to sign all notices, documents, &c., in the name of the Board of Trade.—Mr. Oswald acts as a junior clerk. The total expense of the establishment is estimated at 1400*l.* per annum. The engineer officers employed in the first instance to assist Sir Frederic Smith, were paid two guineas a-day and expenses. The Department is put under the superintendence of the President of the Board of Trade, as consulting member of the Board. It is in contemplation that the establishment must be slightly increased.

In the evidence of the several parties who were present at the celebrated Birmingham Conference for devising the means of preventing accidents, we learn for the first time the reason that the results were so very trifling. It seems that on discussion, the difficulties that stared them in the face as to forming any general system were so great that the attempt was given up in despair, and the parties present silently acquiesced in the resolutions, which had been prepared, at the same time recommending the regulations of the Liverpool and Manchester Railway for consideration and not for adoption. Frightened as they had been by newspaper clamour—into the endeavour to adopt some measure, they were confined in their original views, that as the accidents had not arisen from neglect on the part of the companies, neither yet had they sufficient experience to devise any effective remedies.

We find also some clue to the mode of proceeding of the well known committee of three, whose activity and inactivity were the cause of so much alarm in the early part of the agitation. It appears that when the railway body, dissatisfied with their conduct, found it necessary to take the matter into their own hands, the committee thought proper to disclaim having in any degree wished to bind the companies, a salutary step which seems to have had the best effect.—Mr. Labouchere was thus deprived of the support of this committee, whose neglect of their duties had excited so much indignation, and in place of this pliant body, he had to contend with the great railway interest, representing fifty millions of capital.

Brunel's evidence was the mainstay of the opposition, and abounds in practical information, which we wish that it was in our power to transcribe, but the limited nature of our space forbids. What he says as to engine drivers is of direct importance to the profession, and is so totally opposed to the vulgar opinion on the subject that we are compelled to insert it here.

There is another regulation suggested, and which therefore I presume is to be acted upon; it is that an engine driver shall be able to read his instructions. Now I dare say that appears to a great many gentlemen a very essential thing; but not only do I maintain that it is not essential, but I maintain that the mere laying down that rule as a rule, is a proof that the party suggesting it is not acquainted with the class of men we are dealing with, and that we must deal with, as engine drivers. I should have thought too, that Sir Frederic Smith's knowledge of the world and of military life, of privates, would have told him that the class of men who must be employed as workmen, are not a class of men who learn their instructions by reading, even if they can read; their knowledge is obtained entirely orally. A man of that class has not obtained, as we have, the power of reading and remembering what he reads. Those sort of men will read and derive a little amusement from what they read, but they have not obtained the power of learning things by reading, they learn orally entirely. As to the instructions, it is true we print them, and it is true we make them read them, and we make them sign them, partly to ensure their having an opportunity to see them, but very much to satisfy the public mind when an accident has occurred; but I do not believe the men obtain the slightest knowledge of their instructions by reading; they may read them through and get up with the printed letters in their eyes, but as to obtaining information from it, they do not; they obtain their information orally; and whether a man can read his instructions or not, does not at all affect the question of his being a good engineer or not. Our very best man on the Great Western Railway, the very best engine driver we ever had; a very superior man, who is now foreman of our engineers at Reading, a man whom I trust better than anybody I have got on the line, can neither read nor write, and yet he issues instructions, and he has a clerk who writes written orders; and it would be a serious mischief if any regulation of the Legislature should deprive us of him, and of a number of others that we have. I am not one to sneer at education, but I would not give sixpence in hiring an engine man, because of his knowing how to read or write. I believe that of the two, the non-reading man is the best, and for this reason: I defy Sir Frederic Smith, or any person who has general information, and is in the habit of reading, to drive an engine. If you are going five or six miles without anything to attract attention, depend upon it you will begin thinking of something else. It is impossible that a man that indulges in reading, should make a good engine driver; it requires a species of machine, an intelligent man, an honest man, a sober man, a steady man; but I would much rather not have a thinking man. I never dare drive an engine, although I always go upon the engine; because if I go upon a bit of the line without anything to attract my attention, I begin thinking of something else. The duty of the engine man is the simplest possible thing; he must first of all have a good constitution, and be able to stand rough weather; in fact, a gentleman cannot be an engine driver, or any man who can earn a livelihood in any quiet, comfortable way; he must know something of machinery, to a very small extent; of course he must know the parts of a locomotive engine, and he must be something of a workman, although the fine workmen rarely make good engine drivers; such a very low class of knowledge of the machinery, that I can hardly call it knowledge; a mechanic learns that in a fortnight or three weeks. He must be a sober man, and have all those qualities which are included in the general term of "steady;" I hardly know how to define them; but he must be accustomed to follow orders, not desirous of infringing them; not reckless, and be what is commonly understood by "a steady man."

Sir Frederic Smith was the first witness examined, being in support of the government recommendations—what were the arguments which he used we think it unnecessary to repeat, the public being sufficiently conversant with them. He bore testimony to the harmony with which the companies and their engineers had co-operated with him, and expressed his regret at its being disturbed by the difference which had arisen on the discretionary clause—an ill omen we should say as to the result which would be likely to be realized if the clause had become the law of the land. Sir Frederic was obliged to admit that most of his proposed regulations were inapplicable as general rules, and that the greatest injustice would be the effect of their stringent execution. It must be observed that the intended legislation would have authorized the Board of Trade to interfere with the traffic in many annoying ways, as for instance on the Manchester and Leeds railway, suppressing the mixed train, disturbing the arrangements of lines generally by prescribing an interval between the trains, regulating the speed and the load, crushing small companies by overburthening them with expenses, increasing the police, breaksmen, number of breaks, buffer springs, preventing assistant engines from pushing behind, carrying luggage with passengers, obliging to work by time tables.

Mr. Booth of the Liverpool and Manchester Railway exhibited his usual acquaintance with the subject, and expressed in the strongest terms his objections to the powers proposed to be given to the Board of Trade. He unequivocally stated that he did not consider any central authority or Board competent, in the present state of knowledge as referrible to railways, to take on itself the issuing of regulations. Mr. Booth, as well as the other witnesses who followed on the same side, forcibly dwelt on the melancholy consequences which must ensue from divided responsibility, and showed the injustice of allowing the Board of Trade to make rules, and then punishing the companies for the bad working of them. For a central authority to attempt to regulate the traffic on the Liverpool and Manchester would be productive of the greatest confusion and injustice, on account of the fluctuating nature of the traffic, requiring that arrangements should be made at the moment to conform to it. In appealing against the recommendations already made by the Board of Trade authorities, Mr. Booth forcibly urged that they were such as to show that they had not that experience which is necessary to make them capable of issuing regulations, and that he could not have confidence as to their general discretion in issuing regulations. The proposed fifteen minutes interval between the trains, he showed to be equal on his line to a distance of seven miles. Mr. Booth attributed in some measure the success of the Liverpool and Manchester Railway in escaping accidents to the very great traffic, which obliged every engine driver to be constantly on the alert. Very few accidents, observed he, occur in crossing Cheapside for example; every body is obliged to be on the alert, and, to look about him.—The proposed regulation as to ballast trains he showed would be absolutely impracticable, and time tables equally useless and mischievous. The propriety of leaving the responsibility with the companies, was supported by their witnesses on the ground that they had a stronger pecuniary interest in the safety of passengers, and prevention of accidents than any other parties, and were of course urged to adopt every possible precaution. One company was mentioned as having lost £10,000 by a single accident.

Brunel, whose examination occupied two days, followed in support of Mr. Booth. To the spirit which characterized his examination we have already referred. He expressed more strongly even than Mr. Booth his want of confidence in the officers of the Board of Trade generally and individually, and throughout his examination kept Mr. Labouchere's vigilance fully on the alert, frequently discomfiting him in his attempts to entrap him into a toleration of the interference of the Board, to which Brunel objected in toto. Upon the causes of accidents, the remarks of this engineer fully bear out the views which we maintained both on this and the steam vessel question, and are well worthy of perusal.

I think the officers of the Board of Trade are under a completely erroneous impression both of the circumstances which really lead to those accidents, and of the best mode of remedying them, and that they are without, and must always be without, any sufficient knowledge of the practical working of the system with which they propose to interfere; and I think that the accidents and the suggestions arising from those accidents themselves, prove what I assert. They certainly prove it to the minds of those who are familiar with the practical working of railways. I dare say it will be difficult to prove that satisfactorily to the Committee, from the very circumstance I have just mentioned, that they are not acquainted with the practical detail of the working; but still, if the Committee will allow me, I will attempt it. I think that the mere circumstance of which the officers who have been appointed have themselves given very strong evidence, namely, that notwithstanding the tremendous speed at which railway travelling is carried on, notwithstanding the appearance of almost trusting to Providence as we run along the lines, and the apparently great risks that are run, that notwithstanding all this, it is a notorious fact, and one which is admitted by the officers who have inspected railways, that it is a safer mode of travelling than any other adopted up to the present time; and that, notwithstanding all those apparent dangers, really there is very little danger comparatively: I think that ought to have led them to consider, that, in all probability, the dangers that still exist, do not arise from any glaring prominent defects in the system, which of course those who have brought it to this state of perfection must long since have seen, and that it would hardly be left to those officers to whom the thing must be new, to discover suddenly that we have passed over some of the most prominent and easily removed causes of danger; and I think that, as they become more intimate with the practical working of railways, they will see that the real cause of danger, small as it now is, consists of a multitude of small operating causes, which occasionally and accidentally are all brought to bear, and all operate to produce risk. But the real source of the danger, and the only one which there is any hope of removing, is in a complication of imperfections in a great number of the mechanical parts of the system. We have gradually discovered, that the wheels had better be a little wider in gauge than we made them at first; that they had better not be quite so narrow in the external gauge; that they should be about half an inch wider on the tire; that the guard-rails had better not touch them: that increased care should be given to the gauge of the rail; and that the tail-lamps must be put in a position in which they shall be less likely to be obscured. A number of small things of that sort are gradually discovered, generally speaking, without any serious accident; they are gradually discovered and removed; and thus the original chances of risk are diminished, till, in fact, they do not occur. All those who are familiar with the working of a railway, or with the manufacture of any article, or with the progress of any complicated system of that sort, well know that it is in vain to attempt to make workmen more perfect: it is in vain to attempt to trust to any regulations in such a manner as to expect, that when a new accident occurs, they shall all apply; and that it is still more vain to expect, that they will be all obeyed. It is by gradual and progressive improvements, in all the little details, that the risk of accident is diminished; and it is by that alone that the risk of danger will be removed. This is familiar to us, and to the persons working the railways; but I am sure it cannot have struck the gentlemen who have been sent to inspect the railways; because, first of all, no looking on occasionally will make them acquainted with that which we only learn by seeing it, and feeling it, and feeling the inconvenience of it every day. They also cannot learn it, because we keep progressing so fast, that the knowledge of one day will not apply to the next; and although their own suggestions which they have made after those accidents, and although the reports which have been made by several of them show very great investigation, and a very acute perception of the circumstances, which they happened to be able to lay hold of on the ground after the accidents had occurred, still those suggestions show that they are aiming simply at that which we know cannot be attained, namely, at perfection in the regulations and in the character of the men that we have to employ, and that it is by attention to the multitude of little details alone, th t approximation to perfection can be attained: that that is their view, is evident also, from the suggestions which they have all thrown out after seeing those accidents.

Mr. Brunel remarks on the application of two engines in conjunction.

All chances of collision of course are got rid of between those trains, and the average power of the whole is better obtained; although there again the necessity of understanding exactly the practical operation of the thing is evident, because it is not the case that two engines, when coupled together and drawing a load, will do twice as much as one engine. It is rather a curious circumstance, but I mean to say that the average power of the engines is best obtained by putting them together, if we take into consideration the chances of one engine running a little dry, or of any circumstance occurring to lessen the power of one engine, we do then get the average power of two or three better by sending them together than by sending them separately; and I have no hesitation in saying, that the general rule ought rather to be (though I think it would be bad to have any rule either way) to send them altogether than to send them in trains, each consisting of a single engine.

We are restricted by the space devoted to other objects from giving any greater length to the discussion of this report, and we must leave it congratulating engineers on this partial triumph, obtained at the last hour. We do sincerely trust that it will be a warning to make every exertion on the other questions that are likely to be agitated. Let a stand of this kind be made against the Ten Per Cent. Deposit Clause, let a committee be got on this question, and a relief much wanted will we hope be obtained. In concluding these remarks, we should be guilty of injustice if we did not notice the ability of Mr. Saunder's evidence, and express the great obligations the railways must entertain to Sir Robert Peel for his timely interference. The fairness shown by this statesman on this occasion will we hope prove an encouragement for obtaining a repeal of the obnoxious Ten Per Cent. Clause, as it affords a promise of our obtaining aid, if we do but show a fair case.

NEW AND USEFUL INVENTIONS.—No. 5.

By Philotechnicos.

Patent Decorative Carving and Sculpture Works, Ranelagh Road, Thames Bank, Pimlico.

This invention presents one of those great strides of machinery with which the present day abounds, for superseding manual labour in works of art as well as science. What would our forefathers have said at hearing that carving was to be done by machinery; the idea would have been considered preposterous, and the inventor, at least, a madman; but now it is almost received as a matter of course, and nothing is thought impossible; it is, moreover, most remarkable, that some of these valuable inventions are mere improvements upon simple inventions and schemes of ancient date, and familiar to nearly every one. Who would have thought that the common marking iron, used for stamping or burning the initial or name of the owner on implements of trade, should give the idea of a similar process for a more elaborate purpose—that of carving (if the term can be used) in wood? but so it is—or at least such is my anticipation from its proximity, which the reader may judge of from the description of the method adopted for the patent carving. An iron mould is first cast from a plaster or wood model. The iron mould is heated to a red heat, and applied to a piece of wood, previously damped, with great force, and repeated, until the wood is burnt to the required form. The char is then cleaned off, and any undercutting that may be required done by hand: when the operation is finished it has the appearance of old oak. The surface may be brought almost to a polish, when it assumes a highly finished appearance, nearly equal to the original, though of a first-rate master, from which it was copied. By the great pressure to which the wood is subjected, it is rendered much harder, and is consequently more secure against the action of the atmosphere or insects. The immense uses to which the patent carving can be applied must be obvious to all, and needs but little description; and will afford another opportunity —which I am always glad to give the hint of—to the "Commissioners for Building New Churches," to enliven their "interiors," which now present nothing but naked roofs, plain panelings, and any thing but gothic finishings. How does my imagination brighten at the prospect! seats, "as of old," with their beautifully carved finial standards—pulpits, paneled and moulded to richness—gallery fronts with elaborately carved tablets from scriptural subjects—the altar-piece beautifully ornamented with canopies, crockets, and finials—the roof with rich tracery, bosses, queer-looking heads, cherubim and pendants—the pew enclosures (if any, as I hope, ere long, to see the present kind, entirely abandoned, as in that neat little chapel of St. Katherine in the Regent's Park, where the body of the church contains none of those pen-like objects,) I should desire to see enlivened by the beauties of gothic carving—the communion table, chairs and enclosure, oh, what beautiful objects! elaborate to a degree; carved legs, carved backs, carved balusters—the organ, a gem, a specimen of Gibbons, with that fine, dark, brilliant polish sometimes seen in churches of the olden time. But where does my imagination lead me? were it of use to prophecy, to write, to agitate, I would do so with abundant pleasure; but I fear all the labour would be lost, all my advice thrown away, and all my time and research only wasted upon the desert air, ere they, the said Commissioners, will take the hint upon such a subject; but if they will not, surely the profession have some little influence, and will do their best to enhance the interest of our modern churches; 'tis to them I appeal, and earnestly solicit their support, in the introduction of such ornament as will display their taste and judgment, and give good scope for ingenuity. The patent carving bids fair to accomplish this, as the price—the iron ruler of all architecture—is so considerably less than that of real carving—about one third, and, in many cases, one fifth of its cost.

This invention is admirably adapted to the styles now so much in vogue, the Renaissance, Elizabethan, and Italian, the enrichments of which being so frequently repeated, make the cost of the original mould comparatively small; for upon repetition mainly depends the saving of expense. Articles of furniture are famous subjects upon which these magical operations may be performed; those old fashioned, comfortable-looking, high-backed, walnut tree chairs, with their crimson plushed seats and grotesque-looking ornaments, may be imitated to correctness. Cabinets—the pride of former days, with all their twistings and turnings, can be done with facility, and the work of years performed in as many days. It is needless to enumerate the very many purposes to which the patent process can be applied: suffice it to say, that any work carved in wood or moulded in plaster can be executed by its pyrotechnic influence, save and except the undercutting, which must be, as before stated, finished by hand. A tablet in which figures appear of cupids in high relief, is exhibited at the works, and proves full well the triumphal power of the process; and a medallion portrait of the Duke of Wellington, presented to me as a specimen, shows its use in that department.

Patent Anti-Corrosive Iron Tube Works, Brunswick Street, Blackfriars Road.

These tubes are of wrought iron tinned inside and outside, and are used for gas, steam, or water. The process renders them almost impenetrable to corrosion, and causes them to resist the action of gas or acids, for a much longer period than the common tubes; they are useful to brewers, distillers, operative chemists, and other manufacturers; and for the water companies they would be excellent, on account of the purity of the tin with which they are coated,—they are well adapted for service pipes, being less liable to burst by frost than their softer rivals.

ON THE HISTORY OF ANTIQUITIES.

Sir—The subject of the antiquities of those nations which occupied an early period of history, has frequently attracted the attention of men of learning, who have examined with the greatest care every record which could throw light on the subject of their inquiry.

These inquiries, however, have been always entered into in detached portions for the purpose of studying the history and antiquities of a single nation, and for that reason though they have been made by persons well qualified for the task, their efforts have been to a great extent fruitless, and it yet remains to collect into one focus the result of their separate labours, and by affording the opportunity for comparison to increase their value tenfold. Since the principal records of the periods to which I allude, consist in remains of the useful or liberal arts, such a comparison alone can at all exhibit the influence one nation has had on another in the progress of civilization, and enable us to connect many hitherto detached passages in the history of the arts.

No one has, perhaps, carefully compared the remains of ancient art to be found in Egypt, India, Etruria and Peru, yet we have some grounds for supposing that there has been a connection more or less close between the inhabitants of all those countries: in fact to go deeply into all these histories, by a personal examination of the principal remains, would be too arduous a task for any one individual. Besides the nations before mentioned, an attempt of this kind would embrace the history of the Chaldees, the early history of the Tartars, the Scandinavian tribes, the originators of Stonehenge, and the various constructions called Cyclopean, with the remains of now unknown origin in America, which have lately attracted the attention of the antiquaries of that continent.

Another branch of the same subject intimately connected with the former, and of which the importance is too obvious to require explanation, is that of inscriptions; and I have great reason to think that in this especially, our present ignorance arises rather from the want of a skilful combination of acquired materials, than from a deficiency in those materials themselves.

On these accounts I am ready to believe that any one entering upon this subject and fully carrying it out, (and its comprehensiveness would be its excellence), would confer an important benefit on art and literature.

I remain, &c.

E. L.

ON CONTRACTS.

Sir—I shall feel particularly obliged if you will be pleased to give your opinion, in your next publication, on the question given below, as it will be of great service in guiding me upon the business.

I remain, your most obliged,

Cardiff, May, M. R.

(Case.)

I have been employed in making designs for a Rectory House, and afterwards a specification of the several works, and a very full detailed estimate of every item of expense of building the same, to accompany the specification. Among other things contained in the specification was the sinking of a well (that a well should be sunk to a sufficient depth to obtain water), and in the detailed estimate was an item for sinking the well of 3*l*. 10*s*., as being informed by the Incumbent that the springs were very near the surface (which they are in the adjoining fields), and in the specification in the general condition is the following clause, that all extras, additions, or deductions made to the building shall be measured and valued according to the detailed estimate accompanying the specification. Now the site of the house is an eminence on the limestone stratum, and I have sunk a well to the depth of 78 feet below the surface, without any chance or sign of obtaining water, at an additional expense of 20*l*. over the 3*l*. 10*s*. allowed in the detailed estimate, (which sum I have not made a claim for). Through there being no water the Incumbent will not certify that the contract is fulfilled.—Please to state your opinion on the above.

[We are of opinion that from the wording of the specification alone, that the contractor has not strictly fulfilled the conditions of his contract in the eye of the law; it is one of those foolish unlimited stipulations we see too often inserted in specifications. The specification should have stated not exceeding a certain depth. However, if it can be clearly proved that the Incumbent held out to the parties tendering, that water could be procured near the surface, with a view that such parties should imagine it to be the case, and put down a price accordingly; we are then of opinion that the contractor would be relieved in equity, particularly if he proved that he had sunk the well to a reasonable depth, to show that he had used his best endeavours to procure water—which in the present case we are of opinion the contractor has done.]—Editor.

REVIEWS.

A Summer's Day at Windsor, and a Visit to Eton. By Edward Jesse. London, 1841. Murray.

As a guide-book or manual for the information of those who visit Windsor Castle and its immediate vicinity, this may fairly be styled a superior volume of the kind, it being tastefully got up, and containing several well-executed wood-cuts. That the subjects of the latter are well chosen, and thereby enhance the interest of the book, is more than we can add; for, with the exception of the frontispiece, which is a very useful situation's-plan of the castle, the print showing, in elevation, two bays of the exterior of St. George's chapel, another showing three ditto of the Tomb House, and one or two other cuts, the rest of the illustrations illustrate nothing. Sure we are, that had they not been given, no one would ever have missed such things as portraits of trees, facsimiles of prisoner's hand-writings, the ladies and gentlemen on horseback intended to represent Her Majesty with Melbourne & Co., or the very queer old-fashioned set-out of George III. at the Eton Montem. Of the castle itself—which it may be presumed is, after all, the principal of the lions at Windsor, nothing is shown beyond the Norman gateway—which conveys no idea whatever of the exterior generally—and St. George's Hall, and the Guard Chamber, which last is executed in a most disagreeably hard manner. Surely one or two more interiors might have been introduced; we do not say that such subjects can be furnished as cheaply as representations of stumps of old trees, &c.: we would gladly give every one of the latter for a single illustration of the other kind. While Mr. Jesse affects to entertain the highest respect for Sir Jeffry Wyatville, it is certainly no very great compliment towards that architect to keep him and his work as much in the background as possible—or, rather, to keep them quite out of sight. As regards the Castle in its present state, the letterpress is as unsatisfactory as the illustrations, there being very little indeed on the subject of the building, nothing amounting to opinion, while the description is excessively meagre; we have met with very much more from time to time in periodicals and newspapers. But the hundred and fifty pages must, of course, be filled with something, and so, indeed, they are, namely, with what has been given a hundred times before in various publications—a history of the Castle, interlarded with anecdotes as trivial as they are stale. In fact, the whole is a mere "cram,"—such a production as could have been executed by any journeyman bookseller. It is one of those things which are made to sell, for the same reason that other guide-books sell, and that court calendars find customers. But as the title-page bears a name, we naturally—and, as it now turns out, foolishly—expected to meet with something above the ordinary run of such performances. What Mr. Jesse may be as a naturalist we know not; but here he exhibits himself as a bookmaker, one of those whom Carlyle very unceremoniously calls "respectable literary thieves and paupers."

The Decorator and Artist's Assistant. Edited by J. Page, Author of the Acanthus.

The appearance of this periodical work is, we trust, a proof of increasing taste for design, and viewed in such a light, it meets with our best wishes. Published in weekly numbers at sixpence, and monthly parts at two shillings, it contains a variety of designs for architectural ornaments, furniture, jewellery, &c., and will no doubt be extensively patronized by the artisans to whom it is addressed. We wish that Mr. Page would in every instance give the authorities of the designs which he inserts, by which their value would be much enhanced. There is a want of boldness in the outlines, but as that is attributable to the etching, we cannot object to it.

The Acanthus.

As a homage to the architectural profession we present to their notice Mr. Page's Plate of the Acanthus, designed, drawn and engraved by himself. Mr. Page is, we believe, a self-taught artist, and we know him to be meritorious and hardworking; we hope therefore these will be claims to the patronage of the profession for which he has shown so much respect. As an object of study the luxuriant plant depicted in this engraving will well repay the student who lays out his half-crown upon it. It is a cheap and elegant ornament for the portfolio. We are informed that the drawing obtained a gold medal at the Society of Arts.

We have been obliged to defer our farther notice of Mr. Clegg's "Practical Treatise on the Manufacture and Distribution of Coal Gas," until next month.

PAPERS ON HARBOURS AND RIVERS.

Report on the navigation of the Forth. By Robert Stevenson & Sons, Civil Engineers.

Prefatory Note.—Having been called upon, by the magistrates of Stirling, to revise, with a view to its being printed, the following Report, which was made as far back as 1828, we have done so with much care. It affords us great satisfaction to be enabled to state, that the views contained in the Report have derived additional confirmation from our past experience, more especially in the case of the River Tay, whose navigation was formerly obstructed by obstacles which, although composed of different materials, closely resemble, in their position and extent, those which at present hinder the advancement of the trade of the Forth. By the partial removal of the various fords, the depth of water in the Tay, at spring tides, has been increased from 11 feet 9 inches to 16 feet; and the works, which are not yet completed, have occupied little more than two years. The hardness of the materials which compose the Fords of the Forth may render their removal more tedious; but it ought not to be forgotten, that it, at the same time, ensures greater permanency in the form of the excavated channel. It is therefore with increased confidence that we repeat the recommendations of the Report of 1828.

Robert Stevenson & Sons.

Edinburgh, Dec. 10, 1838.

The Firth and River Forth are navigable for the largest class of merchant vessels, as high as the port of Alloa: and in spring tides, vessels drawing 9 feet water may proceed to Stirling, lying 10½ miles above Alloa, while those drawing 7½ feet water, may reach the mills of Craigforth, 5 miles above Stirling. The improvement of the navigation between Alloa and Stirling, has long been regarded as a desirable object, and was brought under the notice of the Reporter by the magistrates of Stirling, in the month of November, 1825, when it was proposed to petition Parliament for leave to bring in a bill for this measure. * * *

Above Alloa the river becomes very circuitous. By the navigation the distance from thence to Stirling is 10½ miles, while in a direct line it measures only 5 miles. It has been proposed to render the navigation of this part of the river more direct, by cutting through the links, or peninsular necks of land, for which the track of this river is so remarkable. This would shorten the navigable track; but it would have a direct tendency to deteriorate the navigation below, as a great volume of the tidal water, which at present passes over and scours the lower banks four times in the twenty-four hours, would be cut off and diverted from its course. The cutting of the links and straightening the river would also, in a material degree, interfere with the vested rights of the proprietors of the banks, by depriving some of the benefit of a water communication, and destroying the valuable salmon fisheries of others. This plan, therefore, though worthy of consideration, is, upon the whole, judged inexpedient in the existing state of things. The Reporter proposes to improve the present channel of the river by deepening it, and removing part of the numerous obstructions called Fords, and he therefore now proceeds to describe in detail each of these obstructions, and the works which are considered necessary for their removal.

Between Alloa and Stirling there are seven principal fords, or shallow parts of the river, which form so many obstructions to the navigation. It is not believed that incumbrances of a similar geological structure are to be met with in almost any other river in the kingdom. The Firths of Tay, Moray, Clyde, Solway, and the Rivers Mersey, Severn, Thames, and Humber, have their peculiar tides and difficulties, both in the form of rocks and sand banks, but none of these channels are impeded by successive chains of imbedded stones and rocks, appearing at low water, like those called the Fords of Stirling. Various hypotheses have been started to account for the existence of these fords. Some have supposed them to be artificial, arising from stones having been thrown into the shallowest parts of the river at an early period, to render it fordable for cattle. But from the minute examination which the progress of this survey has enabled the reporter to make, he has no hesitation in stating, that they are natural barriers of rock traversing the valley of the Forth, and are what geologists term *whin-dykes*, which, from the continued scouring of the bed of the river, have assumed the irregular appearance now presented by them at low water. Similar formations of whin or greenstone rock occur on the southern face of the Abbey Craig, and also on the northern side of Stirling Castle. The fords, like the cliffs at these places, consist of stones, varying in size from a cubic foot to a cubic yard, imbedded in a matrix of friable rock. The joint effect of the crooked channel of the river, and the obstructions caused by the fords, produces a great retardation in the velocity of the flood, which, in the upper parts of the river, is very sensibly less than that of the flood in the Firth, and travels at the rate of only one mile in five minutes. Although this retardation may be considered to be in part due to the operation of the river current, yet it is obvious, from its languor, that this cannot be the principal cause, and it is therefore to be sought for chiefly in the obstructions offered by the fords. On the days of new and full moon, it is high water at Alloa Pier at four hours and forty minutes; at Tullibody Pier at five hours and ten minutes; at Powis Hole at five hours and ten minutes; and at five hours and ten minutes at Stirling Shore or Quay. The consequence is, that the tide does not attain its maximum height at these three last places, until it has been ebb tide for half an hour at Alloa. It appears further, from this train of observation, that the perpendicular rise of spring tides at Alloa, is about 19 ft. 4 in.; at Tullibody, 16½ feet; at Powis Hole, 12 feet; and at Stirling, 7 ft. 8 in.; while the corresponding rise of neap tides at these stations is respectively 11½ feet, 11½ feet, 7 feet, and 3 feet. There being, therefore, a rise of 19 ft. 4 in. in spring tides at Alloa, and only 7 ft. 8 in. at Stirling, the available depth at that place is less than it would have been had there been no rise on the bed of the river, by 11 ft. 8 in. Before leaving the subject of the tides, it may be proper to remark, that the maximum point of high water at Alloa Pier is 4 inches above the level of the high water at Tullibody Pier, while it is 2 inches lower at Powis Hole, and 3½ inches higher at Stirling Shore.

The great object, therefore to which the reporter would direct the exertions of the Magistrates of Stirling, as Conservators of the Navigation of the Forth, is to the removal of the Fords, which are the chief obstructions to the free passage of the tide waters. The advantage of deepening the bottom in the upper reaches of the river is obvious, as the natural effect of such a change is to permit the tide to flow over the lowered ridges at an earlier period of the tide, and thus to allow high water to take place sooner, before the tide below may have fallen to any considerable extent; while, at the same time, an increased depth is obtained. Vessels may then start from Alloa earlier in the flood-tide, and reach the shallowest parts of the river, near Stirling, at the top of high water. In this view of the method of improving this part of the navigation, it is very satisfactory to know, that a navigable track through the whole of these obstructions may be formed at a comparatively small expense, by the common and simple process of blasting with gunpowder, and the use of flats or lighters fitted with cranes and other apparatus. The Reporter will now describe, in detail, the extent of the operations he considers necessary at the different fords.

On the reach between Alloa and Throsk, he proposes that a buoy, provided with suitable moorings, should be laid down at the seaward extremity of the bank, on the eastern side of Alloa Island, about a quarter of a mile above Alloa Pier. This buoy will be useful as a direction for avoiding an extensive spit of sand, on either side of that island. On its western side a perch or beacon is to be erected as a further guide for that channel.

The commencement of Throsk Ford is about a mile and a quarter above Alloa Pier. The channel on this ford is very shallow, and when the river is in its state of summer water, it dries nearly all the way across; but as this part of the river has the advantage of a perpendicular rise of about 18 feet in spring tides, and 13½ feet in neap tides, the navigation is comparatively little impeded. On referring to the plan and longitudinal section of the river, it will be seen, by the parts coloured red, that little excavation is proposed here. A buoy, however, is intended to be moored in a central position to show the deepest water, and, as a farther direction, a perch is to be erected on the starboard hand. This perch will also serve to point out the proper channel for passing Tullibody Island.

Cambus Ford is about a mile and a quarter above Throsk. The bottom of the channel towards the lower end of this ford consists of large stones and roots of trees, and in its upper part, large boulder stones appear above the surface at low water. The rise of tide at this ford is 16½ feet in spring tides, and 11½ feet in neap tides. The navigable channel to be cleared measures about 500 yards in length, and 30 yards in breadth at the bottom. An average cutting of one foot in depth will give about 20 feet at high water of spring tides at this place. A perch is to be erected on the larboard hand, opposite Tullibody Yare or Pier, and another on the starboard hand, to the westward of the Mouth of the Devon. By this means vessels will be enabled to avoid the foul ground at the bank on the opposite side of the river. The track of Cambus Ford is so obvious, that it is not considered necessary to moor a buoy to point out the deepest channel.

Badneath Ford is about three quarters of a mile above Cambus. Its bottom consists of two irregular lines of boulder stones, crossing the bed of the river with numerous detached masses of the same description. From the winding direction of the channel at this place, the navigation is rendered more difficult than at either of the fords below: and, in clearing it, considerable works of excavation will be required. In spring tides the rise of the water at the lower end of this ford is 16 ft. 6 in., and at the upper end 13 ft. 4 in.: there is therefore a fall of 3 ft. 2 in., on a length of about 1150 yards, which occasions a rapid at low water, when the river is in its summer state. In neap tides, the rise is about 11 ft. 2 in. at the lower end, and 8 feet at the upper end. The length of the channel intended to be excavated at this ford is about 565 yards, and its breadth will, as already proposed, be 30 yards at the bottom. An average depth of cutting over its whole extent of about one foot will be required in order to give a depth of 18 feet at high water of spring tides. A perch is to be placed on the larboard hand at the lower end of this ford, and a buoy at the upper end. A perch must also be placed at Fallin Point on the larboard hand. In passing Polmaise and Scobbie's Pow, no difficulty occurs; near Bannockburn, however, there is a bank where a perch will be required as a direction for the deepest channel.

Manor Ford, about two miles and a quarter above Bandeath, has an irregular and stoney bottom. At the lower end of this ford, the rise in spring tides is 13 ft. 8 in., and at the upper end 12 ft. 6 in.: and in neap tides about 8 feet and 6 ft. 10 in. respectively; there is consequently a fall at low water of 14 inches which occurs on a length of 666 yards, and produces a considerable rapid at this place. The extent of ford proposed to be cleared measures about 666 yards in length, and the breadth and depth of the channel to be formed will be the same as that already specified. This will require an average cutting of 18 inches in depth. From the curved form of this channel, a perch will require to be laid down on the larboard side, for each end of the ford, and a buoy must be moored in a central position on the starboard hand.

The Sow Ford is about three quarters of a mile above the Manor Ford, the bottom is stoney and irregular, and its direction also forms a curved line, but as the bottom presents fewer obstructions to the current than the two fords immediately below, there is no visible rapid at this place. Spring tides here give a rise of 11 ft. 9 in., and neap tides 6 ft. 9 in. It will be seen, on referring to the plan and section that the works of excavation at the Sow Ford are not extensive. Instead of mooring buoys to point out the direction of the deepest water, it is proposed to erect two perches, the one on the starboard and the other upon the larboard hand. Wherever perches can be introduced they are considered preferable to buoys, which are more expensive both in their first cost and future maintenance.

The Abbey Ford is situate about a mile above the Sow Ford, and has already been excavated to a limited extent with a view to its improvement: but the excavation wants extension, both in breadth and in depth, to render it useful. The current here is still so much obstructed that it causes a considerable rapid when the river is in its summer state; the fall being no less than 2 ft. 6 in., on an extent of about 500 yards. Spring tides rise, at the lower end of this ford, 11 ft. 6 in., and at the upper end only 9 feet; and neap tides rise 6 ft. 9 in. at the bottom, and 4 ft. 3 in. at the top. The length of the excavation will be about 565 yards, with a breadth of 30 yards, similar to that of the other fords. The average depth of excavation, in order to obtain 13 feet at high water of spring tides, will be about 2 feet. Connected with this ford, two buoys are proposed to be moored on the larboard hand, the one at the lower, and the other at the upper extremity of the ford; and a perch must also be erected on the starboard hand.

The Town's Ford is situate about 500 yards above the Abbey Ford. The foul ground at this place extends about 1000 yards in length, and the works of excavation, in obtaining a navigable track, similar to that of the other fords, will be proportionally more extensive. Spring tides rise only 7 ft. 8 in. at the Town's Ford, and neap tides about 3 feet. Its bottom is very irregular and rocky, forming a great obstruction to the trade of the town, and the navigation of the upper parts of the river. The average depth of cutting at this ford will be 2 feet. For pointing out the deepest water of the new channel which it is intended to excavate, three buoys upon the larboard hand are considered necessary.

The results of the operations which the Reporter has described will be to deepen the river at those points where the obstructions occur; and the depths which are intended to be obtained at high water of spring tides are as follows at the various fords, viz.:—Throsk Ford, 22 feet; Cambus Ford, 20 feet; Bandeath Ford, 18 feet; Manor Ford, 16 feet; Sow Ford, 15 feet; Abbey Ford, 13 feet; Town's Ford, 13 feet.

By thus proportioning the depths at high water on each ford to its distance from Stirling, it is expected that vessels drawing 13 feet will have sufficient water over the lower fords at any period of flood, and will thus be enabled to reach Stirling at the very top of high water, and get the full advantage of the most favourable time of tide in the shallowest parts of the river.

The shore, or quay of Stirling, extends 200 feet or thereby along the right bank of the river, and consists of a breast-wall built in a rude manner with boulder stones, without the usual and necessary provision of defenders or wooden stretchers to prevent vessels from receiving injury while lying at their moorings. Vessels must consequently lie off in the stream to the great inconvenience of the mariner and trader. In any improvement, therefore, upon the navigation of the river, the unserviceable state of the quay-wall at Stirling should not be forgotten; but measures should be taken for rebuilding it, at least to some extent. The accommodation on this wharf is also very circumscribed and defective, but it may easily be extended and improved, as proposed to the Magistrates by the Reporter some years since. The road from the shore should also be formed on a more easy line of draught. It would likewise prove a great convenience to the southern parts of the town and the lower districts of the county, if an additional wharf, and a road from thence, were formed about the central part of the Town's Ford; as also proposed in the report above alluded to. In conclusion, the Reporter has to state as the general result of his inquiry, that it appears, from the annexed estimate, that by an expenditure of about £10,126 4s. the fords of the Forth might be cleared, so as in spring tides to admit the passage up to Stirling of the ordinary class of merchant vessels drawing about 13 feet water; and he cannot but think the importance of such an improvement far outweighs the capital required for its attainment. The position and rising importance of Stirling is too obvious to be longer neglected. It is the natural emporium of the Western Highlands, and lies in front of an extensive and fertile district, containing many valuable waterfalls and other facilities for the establishment of large manufactories.

ROBERT STEVENSON.

Abstract estimate of the probable expense of the works of excavation, mooring buoys, and erecting perches or beacons in the several fords and reaches, on the river Forth, between Alloa and Stirling, agreeably to the foregoing report.

	£	s.	d.
For the expense of works of excavation and removal of stuff, and for mooring a buoy and erecting a perch connected with the reach between Alloa and Throsk, - - -	£ 72	1	0
For works of excavation, &c., at Cambus Ford -	618	18	0
For ditto ditto Bandeath Ford -	654	13	0
For ditto ditto Manor Ford -	918	7	0
For ditto ditto Sow Ford -	139	10	0
For ditto ditto Abbey Ford -	1787	16	0
For ditto ditto Town's Ford -	2747	5	0
For works of masonry and for re-building and extending Stirling Quay - - - -	1200	0	0
	£ 8138	10	0
Incidents on the above sum of £8138 10s., at 20 per cent. - - - - - -	1687	14	0
	£ 10,126	4	0

"ON THE IMPROVEMENT OF RIVERS, &c."

SIR—In your review last month of my Treatise on the Improvement of the Navigation of Rivers, you have given an entirely erroneous version of my views, by an unfortunate mal-arrangement of your quotations. This has possibly arisen in the press, nevertheless every scientific or practical man must feel bound, after merely reading your review, to pronounce the work quite undeserving of the approbation with which you and other literary characters have been pleased to honour it.

In chapter 2, is my definition of the regimen, or state of those rivers which are free from bars, and the plain inference to be drawn from this chapter alone must be, inasmuch as "like causes produce like effects," that we can only ensure the improvement of defective, or bar rivers, by approximating their condition to that of those which are in the required state.

In chapter 3, I give a representation of those features of the regimen, or state of bar rivers, which mark the difference between them and those which are free from bars.

In chapter 7, "*on the course to be adopted for the improvement of the depth on the bars of rivers, and in their channels*," I state, "the reasoning in the preceding pages on the causes of the formation of bars, suggests the course to be adopted for their amelioration, by the removal of all those inner banks, or shoals, stretching like dams across the river, which have the effect of preventing the rapid discharge of the backwater during the proper tidal duration of the ebb."

Again, "seeing that the existence of bars is to be attributed to the too great declivity of the bed of the river, or to that of its low water surface, the impropriety of forming dams across a tidal river, with the view of converting it into a line of navigation by the means of locks, ought to strike every reflecting mind as a measure which should never be adopted when there exists any possibility of obtaining the requisite depth of water by deepening the bed of the river."

In lieu of giving the above, you have merely quoted as my means of improvement, a case or exception, in which I have supposed the existence of impediments to carrying the preceding views into execution, such as the great expense of lowering a long length of rocky bed, which expense the trade of the port might not be able to bear.

Considering the error into which you have been misled, by forming your opinion upon the excepted case, in lieu of the general rule which I have advanced, I am not surprised that your views of the utility of my theory do not coincide with the favourable opinions it has elicited from other scientific quarters.

In my account of the former theories on the cause of the formation of bars, I have given the names of every author who to my knowledge has advanced upon the subject any thing beyond the opinions generally held. I did not give the name of the author of the fourth theory, because my quotation is only from a paper signed Nauticus, in the Nautical Magazine for 1837, page 487; a work much used for the diffusion of information connected with hydraulic engineering.

I perceive in your May number that Mr. Henry Barrett avows himself the author of the paper signed Nauticus.

Mr. Barrett also takes credit to himself as the originator of the suggestion of the "formation of harbours with double entrances," a principle which he says, "is now recommended by the commissioners in their report of a survey of the harbours on the south east coast." But there is no piracy of Mr. Barrett's conceptions in this, inasmuch as harbours with double entrances have been in existence for many centuries; neither is there any resemblance between the *bonâ fide* harbours of refuge proposed by the Government Commissioners to be constructed in five fathoms at low water, upon the principle of the Plymouth or Cherbourg breakwaters, and the harbours proposed by Mr. Barrett to be constructed at Dungeness, or Lowestoffe Ness; the latter being mere inland excavations, with channels of approach to them to be cut through the drifting shingle beach; but which channels and excavations are to remain for ever afterwards clear of deposit according to the theory of their projector Mr. Barrett. In my humble opinion they would speedily fill up again and become *terra firma*, notwithstanding the double entrances. Any scientific or practical man on examining Mr. Barrett's plans for harbours, will immediately perceive the error which has been made in believing that there would be any current *through* the harbour, as this could only take place if the course from one entrance to the other, *through* the harbour, were shorter than by the coast line.

In the Nautical Magazine for 1838, page 97, is a full description of Mr. Barrett's harbours of refuge, and a reply to his theories on bars. "Lowestoffe Ness is a flat point of sand and shingle, which has been slowly but continually increasing and extending further into the sea; towards the centre of this Ness it is proposed to excavate a basin of some three acres, and it is intended to open a channel north and south into the sea on either side of the Ness. These entrances being protected with short piers, and once opened to a depth of fifteen feet at low water, (no very easy job,) are thenceforth, and for ever after, so to remain at the simple *ipse dixit* of the engineer. I doubt it; I will ask any unprejudiced person acquainted with this part of the coast, the flow of tide, and the harbours in the neighbourhood, whether it is not much more likely that it will not only be barred up, but "blocked up and lost?" But Nauticus (Mr. Barrett) says, "The sole cause of bars at the mouths of harbours is the conflicting action of effluent currents passing into the ocean at *right angles* with the shore," and in reference to this theory of Mr. Barrett, and his subsequent statement that "there is no exception to this rule to be found on the whole surface of the globe," Investigator quietly observes, "assertion is not argument, nor a reference to the maps of the world, demonstration on such a point." Investigator also calls upon Nauticus (Mr. Barrett) for the names of the scientific men who he states are converts to his theories. In Mr. Barrett's letter of the 25th ult., to give weight to his statements he also adds, "numbering as I do among converts to my *thesis*, some of the most eminent scientific and practical men of the day;" and again, in reference to his theory, "I state this from observation of more than twenty years made on harbours and bars on various parts of Europe and in Africa." Now, Mr. Editor, I repeat with Investigator, that it would be far more satisfactory to be able to reason upon facts produced by Mr. Barrett, in lieu of loose statements, and the shadows of opponents. Without troubling Mr. Barrett to give us an account of the rivers on the coast of Africa, (though by the bye I have lately seen that an attempt has been made to get rid of the bar of the Kowie River, by giving the latter a direction at right angles into the sea, in lieu of its old oblique course, which by Mr. Barrett's theory ought not to have been attended with a bar), I will merely ask if my information be correct as to the statement, that the river Yare (with which Mr. Barrett is locally well acquainted) is now made to discharge its waters at right angles into the sea, and that the depth on its bar is much greater than at any known former period; or when it discharged its waters into the sea with an acute angle with the shore, when the navigation was nearly lost, and the inhabitants had to cut a direct channel through the dunes into the sea.

I am your obedient servant,

W. A. Brooks.

Stockton-on-Tees, June 1841.

KENT, THE ARCHITECT.

Sir—While I quite agree with Mr. East in regard to Kent's merits as an architect, I cannot help regretting that he should have slurred them over—at least, have passed over them so lightly without at all dwelling upon them, or even mentioning by name, a single building by him. I am rather surprised too, that while speaking of Kent, Mr. E. should not have taken Mr. Allan Cunningham to task, for the supercilious and even contemptous tone in which he has expressed himself of one who deservedly ranked so high in his day both as an architect and landscape gardener, in which last capacity he may be considered the father of the so-called English style of laying out pleasure grounds. A just tribute to his memory, in that character, has been paid to him by the writer of a paper on the subject of ornamental gardening in the Foreign Quarterly; of Kent's abilities as a painter, perhaps, the less that is said the better, but Holkham alone, would suffice for his architectural reputation, for though susceptible of improvement in some respects, it is incontestably one of the most complete residences in the kingdom,—a perfect model in regard to internal arrangement and convenience, and likewise elegance of style, and variety of effect. Every part of the plan is carefully studied, and every apartment is beautifully finished. Though by no means aiming at architectural decoration, the statue gallery is one of the most charming rooms I ever beheld,—of a beauty actually fascinating, and the view from the octagon tribune at either end affords a most striking scenic effect. Never have I seen a single plan of Palladio's which at all approaches that of Holkham, or I may say, which is not more or less disfigured by glaring blemishes and defects. Nevertheless, Cunningham makes no scruple of saying: "little interest attaches to a controversy about such a design: it is heavy and monotonous, and stamped with all the faults, which were many; and all the beauties which were few, of him who proudly wrote himself 'Painter, Sculptor, and Architect.' "—No doubt this is a neatly turned, antithetically pointed sentence; yet it is ungenerous and unjust; particularly when it is considered what an immense stride forward Kent took, from the clumsy and monotonous arrangements which had till then prevailed in the mode of laying out houses of that description.

Such being the case, I am surprised that Mr. East should not have instanced Holkham, as being the noblest work of its class and period in our architecture of the last century. That he is not sparing of admiration towards Kent is evident enough; but at the same time he has expressed himself in such general—or rather such exceedingly vague terms, that it is hardly possible to make out any definite meaning. Nay, he almost seems to deny Kent one of his chief merits, when he talks of his being an artist rather than an architect, since the princely residence above-mentioned is one pre-eminently marked by excellence of plan, and other strictly architectural qualities. Or shall I say that Holkham did not occur to Mr. E.'s recollection when he was writing his more florid than perspicuous eulogium? If unacquainted with what Arthur Young says of Holkham, he will doubtless thank me for pointing out to him that writer, whose Tours, though professedly agricultural, contain a very great deal also of interesting matter, relative to the mansions and seats he visited in different parts of the country,—far more indeed than is to be obtained from others who have confined their attention to buildings and collections of pictures. I may also here mention a paper exclusively on the subject of Holkham, in the fifth volume of Elmes' Annals of the Fine Arts, which may be recommended as an able piece of architectural criticism.

I remain, &c.

Z.

CANDIDUS *versus* S. L.

When S. L. spoke of my making so free with the Professor of Architecture, it certainly looked very much as if he thought it rather a piece of presumption on my part to make any animadversions at all on opinions delivered from such an authoritative quarter. Nevertheless he now professes to wonder where I find any expression of his that seems to discountenance discussion of the opinions of public men,—in which light, I presume, the Professor of Architecture at the Royal Academy may fairly be considered, in regard to his own art, although he is not a public character in the political world. Whether it be with regard to these last alone that S. L. is ready to allow "the roughest handling," I know not; but he might perhaps have spared himself the qualifying proviso, viz., "if it be kept within the bounds of truth and reason," because it would be exceedingly difficult indeed to ascertain and lay down those bounds in a clear and satisfactory manner. I myself, for instance, should say that I did not in the slightest degree transgress them. Or, "by keeping within the bounds of truth and reason," are we to understand that we are at liberty to say only just as much and no more than will be approved of, and allowed to be perfectly reasonable, by the party animadverted upon, or by those who take just the same side of the question? In such case, I most assuredly have on many occasions shown myself to be an outrageously unreasonable sort of person;—I hope I ever shall continue to do so.

To come to something more tangible,—S. L. says he cannot see the propriety of adopting the mode suggested for Gothic windows; yet to most other persons I think it must be obvious enough, because all the objections—and I will add reasonable ones—against glazing with small *quarrels* or panes set in lead, are removed at once, and still the beauty and character of the style, as regards moulded mullions, and tracery, fully preserved. Such window may very properly be compared to an open screen,—and wherever placed, a screen of that kind may, I conceived, be described as *open*, in contradistinction from one with solid panels—though filled in with glass.

When he talks of Gothic being objected to by most persons on the score of its interfering too much with comfort, if it is to be properly treated, I must confess I do not understand him; because if "properly" treated, that style may be made to conduce quite as much to comfort and even to luxurious refinement, as any other; that is provided it be treated not only "properly" in regard to the elements and details of the style, but ably and intelligently, so as at the same time to secure all those improvements in domestic architecture we are now familiar with.—As for fac-similes of old halls and manor houses, I would leave them to such fac-simile people as would relish a Gothic dinner off the wooden trenchers of the good old times. Most assuredly, George IV., who was supposed to be as studious of personal comfort and convenience as any gentleman need be, was not one of the persons alluded to by S. L.; otherwise he would have had modern sash windows put into all the private apartments of Windsor Castle.

S. L. still insists that *invention* is the *object* of the architect when he employs either the Grecian or Roman style, though he allows—perhaps upon downright compulsion, that originality is not always the result. Nevertheless it would certainly appear that *direct imitation* is not generally aimed at; or shall we say that the numerous modern copies of ancient porticos we have beheld of late years, are so many proofs of invention though unluckily no originality has ensued from it? As for the originality of St. Stephen's, Walbrook—I am S. L.'s most humble servant, but he really must excuse my admiring it. I am aware that to extol it, is perfectly orthodox; yet it never was my doxy, nor was it that of Dr. Anderson, who has given it the "roughest handling" imaginable in his Essay. With regard again to the spire of Bow Church, I admit it to be original enough—as unlike any thing in classical architecture as possible; still it is no favourite of mine; nor is it worthy of being put into competition with that of St. George's, Bloomsbury, which last I will boldly assert to be by far the finest composition of the kind in the metropolis—I might say in England; nor am I altogether solitary in this opinion, having heard nearly the same opinion of it expressed by several professional men. I am asked, however, if I can point out any modern Gothic building possessing as much originality as the two examples quoted for my edification by S. L., I therefore say that the design for the New Houses of Parliament, displays quite as much originality, and of a far better kind, and would also refer to Cossey Hall, and Harlaxton as being highly satisfactory specimens of modern buildings, in which the Gothic has been treated with originality *con amore*. The hardest charge of all against me remains to be answered: I am quite regardless, it seems, of decency in the choice of my expressions—I believe I was once so indecorous as to write at full length, the naughty word "breeches-pocket," and I may possibly on some other occasions, have expressed myself with rather more energy than decorum; but I am not conscious of having ever made use of any expressions of which a gentleman would be ashamed, although of many that would shock those demure, hypocritical persons who are choice indeed as to their words, and seldom further than mere words. However, if S. L. can show up my indecencies and indecorums, he is perfectly at liberty to do so; and then I shall understand better than I now do, in what they consist. For my own part I have no great fancy for the milk-and-water style of writing, nor do I think it at all calculated to operate efficaciously. Did I consider architects to be infants, I should prepare and administer my doses accordingly; whereas there are many it would require a Sixty-Candidus power in order to make any impression upon them. Dainty drawing-room phrases are therefore quite out of the question: to use them—pshaw! it would be like trying to tickle a rhinoceros with a rose-leaf.

Candidus.

DESIGNS WANTED.

Sir—In the *Times* newspaper of to-day (June 4th) is an advertisement inviting architects to send in designs for a Corn-Exchange to be erected at Sudbury, in Suffolk, the drawings for which are to be sent in on the 10th; so that barely three days altogether are allowed for making them, and not even that, unless a person chooses to go entirely by guess, without writing to the secretary (at Sudbury) for further particulars, or rather, for particulars, no other information being supplied by the advertisement than that there will be an area of 78 by 50 feet, yet whether that is the extent of the whole site, or merely of the part of the building appropriated to the Exchange itself, does not very clearly appear.

Surely the people who insert such advertisements must suppose that architects keep a stock of ready-made designs by them, suited for every occasion; or perhaps they may imagine that architectural designs can now be manufactured by steam, and perhaps we shall next be told that the required drawings are expected to be sent down by return of coach or train.

Undoubtedly, if an architect be pricked on with a golden spur, he will be stimulated to extra exertion. But on this occasion, the golden spur has been hammered so very thin, that it is as light as a feather. Hardly, perhaps, will you believe me when I say, that the two premiums amount together to the *extraordinary* sum, as it may very properly be called, of Eight Guineas! viz. Five for the first, and Three for the second! The man who would nibble at such a bait, would nibble the cheese put as a bait upon a mouse-trap. Leaving the preposterous shortness of time allowed out of the question, no professional man, I conceive, would pay attention to such an invitation, stamped as it is with excessive paltriness on the very face of it. Therefore, if responded to at all, it is likely to be so only by junior clerks and office assistants. It might be imagined that so gross a practical blunder as that of affording no time whatever for at all considering the subject—hardly sufficient, indeed, for putting down the first rough ideas upon paper—would not be committed by even the most ignorant. Nevertheless, such we find to be frequently the case, and what is more, that the profession itself makes no effort to put an end to it. One way would be to show up and make an example of every case of the kind. And I would further suggest, that the Institute ought to keep an exact register of all competitions advertised in the public papers, and of their respective particulars and conditions. But, unfortunately, the Institute does not seem disposed to bestir itself in earnest or to the purpose on any one occasion. It seems to be not only without the power, but without the slightest inclination, to effect any good, either for the art itself, or for those who follow it.

I remain, &c.,
Anti-Humbug.

New Steamer at Brighton.—We learn from Brighton that a new steamer built at North Shields for a company at Brighton, and fitted with Mr. Smith's patent screw propeller, on the plan of the Archimedes, arrived at the Chain Pier, on Tuesday morning, from the river Tyne, after the remarkable quick passage of 48½ hours. This vessel is intended to ply from Brighton to the adjacent ports, and to be occasionally used as a tug in towing vessels in and out of Shoreham Harbour. She is about 110 tons, with engines of 45-horse power.

Steam Communication between Dresden and Prague.—The first steam boat that ever made the passage between Dresden and Prague arrived from the latter city on the 30th ult. She is called the Bohemia, and was built expressly for that service, being flat-bottomed, having 121 feet in length, and 13 ft. 6 in. in breadth. Her engine is of 49-horse power, and she is capable of carrying 40 passengers, and a considerable quantity of merchandise. When laden with a full freight she draws only 16½ inches of water, and makes the passage in about 16 hours. She is to travel to and from the two cities every three days.

NEW INVENTIONS AND IMPROVEMENTS.

STEAM ENGINE FURNACES.

EXPERIMENTS ON THE ECONOMICAL EFFECTS OF FURNACES OF DIFFERENT CONSTRUCTION, AND ON DIFFERENT KINDS OF FUEL.

These experiments have been made by a committee appointed by the Society of Industry of the Grand Duchy of Hesse, and their object has been,

1st. To ascertain the useful and economical results of furnaces for boilers constructed on different principles.

2nd. To establish the relative value of the combustibles most generally used in the country.

We do not consider it necessary to enter into the details of the experiment; we will only mention the results.

In order to decide the first question, a common boiler was set over a furnace of brickwork provided with a chimney, and this apparatus for heating was submitted to various modifications, as regarded the form and structure of the hearth as well as the disposition of the flues.

In order to resolve the second question, experimental trial was made of good dry wood chopped from the beech tree; of good coal from Roer, called *Fettschrot*; and of square pieces of turf from Greisheimer, perfectly dried, and of the heaviest kind.

The different modifications used in the construction of the furnace were the following:

I. Furnaces without flues or draught chimneys, the boiler being suspended freely above the fire.

II. A simple flue passing round the boiler, the bottom part of which only was immediately exposed to contact with the fire burning in the grate.

III. A double flue, that is, a flue going twice round the boiler in the same direction.

IV. A stove arched in the shape of a cupola, and having an opening in the middle of the arch, which became gradually wider towards the top, and by which the heat ascended, and was communicated to the bottom of the boiler, to be afterwards conveyed by three holes, placed at regular distances, into a circular passage which surrounded the boiler; to issue thence through three similar apertures differently arranged, and which communicated with a second passage placed higher, whence the draught was at length conducted into the chimney.

V. Two half flues, that is, each of which did not extend beyond half the circumference of the division of the boiler. The fore part of the flame (on the side next the door) ascended from the stove, and was distributed half into the flue on the right, half into the flue on the left, and was finally conducted into the chimney at the point where they met.

VI. Four half flues, or two on each side the boiler (from right to left); the flame issuing from the side opposite the door entered into the lower flue, then passed half the circumference of the partition of the boiler, and entered into the upper flue, whence it was finally conducted into the chimney.

The relative effects of these different arrangements have been ascertained, both with respect to the quantity of water evaporated in the boiler, as well as that of the combustible employed; particular care being taken to keep up the same level in the boiler after each experiment.

In the following table, which contains results of the experiments, the numerals indicate the different methods of construction of the furnaces in the order in which they have been described above; the figures placed underneath indicate the relative qualities of the combustibles employed to obtain a similar result; consequently the greater amounts indicate the worst methods of employing combustibles:—

Wood	VI	V	III	II	IV	I
	63	68·8	68·69	72·19	72·23	100
Turf	VI	III	IV	V	II	I
	53	66	71	72	76	100
Coal	III	IV	II	V	IV	I
	73	76	83	85	91	100

The following are the conclusions to be deduced from the foregoing table:

1. The fire over which the boiler was placed without flues was attended with a less advantageous use of combustible than those with flues.

2. The utility of flues is much more perceptible in fires of wood or turf than in coal fires, because the result is a saving in fuel of about one-fourth to one-third with wood, and almost of one-fourth to one-half with turf, and only of one-tenth to one-fourth with coal, by the addition of flues.

3. The mode of construction with four half flues (No. VI.) may be considered to be generally the most advantageous. Next to this the construction with a double flue (No. III), which in its mode of action bears the nearest resemblance to it. With respect to the arrangements Nos. II., IV., V., the effects they produce are nearly similar.

4. The double flue (No. III), which surrounds the whole boiler, is attended with better results than the single flue (No. II); according to the same principle, four half flues (No. VI) are attended with better results than two half flues (No. V).

5. With the fire of wood and of turf, two half flues (No. V) have more effect than a whole flue (No. II), and four half flues (No. VI) more than two whole flues (No. III); in short, flues which encircle only half the boiler are in this case more effectual; while with a coal fire it is precisely the contrary. The cause of the difference is doubtless this, that in such combustibles as wood or turf, which blaze brightly, a retardation of the heated air, which in these half flues produces a sudden change in the direction of its motion, is more advantageous than with coal.

With respect to the calorific power of the different fuels, there results from equal weights of turf, 96, and of coal, 250, when that of wood is considered equal to 100.

The great difference that is found in combustibles, with respect to their natural quality and their composition, as well as in their degrees of dryness, can scarcely admit of forming points of comparison between these latter results and any other given case. It is well known that there are turfs which from an equal weight throw out more heat than wood; but the results with respect to the different methods of constructing furnaces are more to be depended on; because in these are remarked a degree of regularity in their effects, and it is easy to account for the causes on which the differences depend.—*Moniteur Industriel.—Inventor's Advocate.*

LOCOMOTIVE EXCAVATOR.

This French machine is stated to be the invention of M. Gervais, of Caen. The trial of the apparatus was made in the presence of a committee of the Society of Emulation at Rouen, and of many of the distinguished residents of the town, and the result is said to have left no doubt of the possibility of making excavations by the power of steam. It is said to be particularly applicable in digging canals, and making the excavations for railways. The apparatus is placed on a large heavy kind of carriage, in the fore part of which there is a steam-engine of six horse power, with oscillating cylinders and a tubular boiler, which works the machine, and also turns the two fore wheels very slowly, so that the whole is gradually moved forward as the work progresses, large pieces of wood being laid down to form temporary rails over which the machine is propelled. Towards the back of the machine there are two machines similar to dragging machines, which raise the earth that has been dug out, and deposit it in a horizontal endless chain of buckets, which carry the excavated earth beyond the limits of the trench, and there deposit it, forming an even and regular bank on each side. The excavating apparatus is placed about the middle of the carriage. It consists of four iron shafts parallel to each other and equi-distant, the whole four having their axes in the same plane, and forming an angle of fifty degrees to the horizon, the incline being towards the back of the machine. Each shaft has attached to it five double arms, equi-distant from the bottom to the top, and each arm is furnished with a spade-shaped tool. These shafts, therefore, present forty spades working at different heights, which dig a ditch nearly three metres in width and upwards of one metre in depth. Each of these excavating tools when in action strikes against the earth ten times in a minute. These revolving excavating shafts are put in motion by the steam-engine, and the action of the engine is so regulated that the whole machine progresses at the rate of about twelve metres an hour. The whole of the machinery, including the carriage, weighs about 21,000 kilogrammes, or 15 tons. When, owing to the nature of the soil or the presence of large stones, the action of the tools is resisted, the locomotion is stopped, and the whole apparatus is made to back, so as to enable men to remove the obstruction. The trenches dug by this machine are very exact, the sides are perpendicular and smooth, and the earth thrown out forms on each side a regular embankment. A machine of this kind was some time since shown by M. Gervais to the French Academy of Sciences, on which they reported very favourably, but it was not provided with the means of locomotion, nor was it on so large a scale as the machine at Rouen. *Ibid.*

CALOTYPE.

It has been known for some time, that Mr. Fox Talbot, in the progress of his experiments to render more perfect the art of photogenic drawing, had discovered a means by which paper could be made far more sensitive to light than heretofore. The impressions, however, so quickly obtained by this new method, are in the first instance *invisible*, but by a process similar to the first, they are made to appear with even greater power than in ordinary photogenic drawing. On Thursday evening, June 10, Mr. Talbot read a paper at the Royal Society, in which he described the new process, called, for distinction's sake, *Calotype*; and as the subject is one of general interest, we shall here briefly describe it:—The paper is covered with iodide of silver, by washing it successively with nitrate of silver and iodide of potassium. Afterwards it is washed over with gallo-nitrate of silver, the greater part of which is removed by immersion in water, but enough adheres to render the paper exceedingly sensitive to light. The paper is then dried, and placed in the camera obscura, and the image of a building, or other object, is generally obtained in less than a minute. This image, however, is usually quite invisible; and the mode of rendering it visible (which is the most curious part of the Calotype process,) consists in washing it again with gallo-nitrate of silver and then gently warming it, which generally causes the appearance of the picture with great force and vivacity in the space of a minute or less. The gallo-nitrate of silver is formed simply by mixing solutions of nitrate of silver and gallic acid. The operation requires to be executed with great care and precision, but is not difficult in other respects. The theory of the process remains, at present, unexplained.—*Athenæum.*

IMPROVEMENTS IN FURNACES AND BOILERS.

Charles Wye Williams, of Liverpool, gentleman, for certain improvements in the construction of furnaces and boilers. Enrolled at the Petty Bag Office, May 17. Claim first.—The use and application of metallic pins as conductors for transmitting heat. This part of the invention consists in inserting metal pins in the plates of which boilers, evaporating pans, &c., and pipes, &c., attached to the same, are composed; part of each pin extending through the bottom of the vessel into the liquid to be heated or evaporated, and the other part projecting outside of the vessel into the fire beneath it, by which arrangement a greater quantity of heat is transmitted to the liquid than there would be by the usual method.

Claim second.—The mode of giving the longitudinal and vertical movements to the fire-bars of a furnace; also the extension of the fire-bars outside of the furnace, so as to receive fuel from a hopper, and spread it evenly over the fire-grate.

The fire-bars are serrated (the elevated parts being wedge-shaped, and the depressions quite smooth), and incline downwards from the fire-door towards the bridge of the furnace, their lower ends resting on a bar, on which they are capable of moving verticallly up and down as on a centre; the other ends terminate beneath a hopper outside of the fire-place, but within the fire-door; they are supported at this end by eccentrics placed on a horizontal shaft, which, being turned by hand, or by gearing from the steam-engine, communicates the up-and-down movements to the fire-bars, and the fuel being received from the hopper on to the outer ends of the fire-bars, is urged with a gradually diminishing force towards their inner ends, and spread evenly over the surface of the fire-grate. By the continued movements of the fire-bars the generation of clinkers is prevented.—*Inventors' Advocate.*

IMPROVED APPARATUS FOR CUTTING AND SHAPING METALS.

Joseph Whitworth, of Manchester, engineer, and John Spear, of the same place, gentleman, for certain improvements in machinery, tools, or apparatus for cutting and shaping metals, and other substances. Enrolled at the Petty Bag Office, May 17.

The first part of this invention consists of an improved die for cutting screws. The principle upon which this die is formed may be described as effecting the following object, viz. to cut a screw-thread at any required depth with dies, which have themselves been cut by a master-tap, double the depth of the thread, larger in diameter than the shaft on which the thread is to be cut. The improved die is formed from the common die, by dividing the same either into two equal parts (the plane of section being parallel to the sides of the die), or into three unequal parts, in which latter case the two planes of section are parallel with each other, but at an inclination to the sides of the die. In working this die, its plane of direction, instead of passing from the axis of the shaft on which the thread is to be cut to the centre line of the die, as in ordinary dies, passes outside of the said line. The patentee shows an improved stock, of a very simple construction, to be used with the die.

The second part of this invention is an improved mode of actuating the planing machine, described in the specification of a patent obtained by Mr. Joseph Whitworth, in 1839.

The third part of this invention consists of improvements in slotting machines, the chief feature of which is the compound moving table. This table consists of three parts, the lower part sliding along the bed of the machine; the middle part moving at right angles to the lower one; and the top one having a rotary movement communicated to it.

The fourth part is an improvement in the slotting bar. An angular groove is cut down the back of the bar to receive a strip of metal tapped for small set screws, by which the positions of the cutters are adjusted, and in the front of the bar recesses are scooped out round the cutters, to afford room for the cuttings.

The fifth part is an improvement in the slide lathe, and consists in attaching an apparatus to the headstock or mandril frame of the lathe, for the purpose of forming, together with the change-wheels, a more perfect communication between the mandril and guide-screw.

The last part consists of an apparatus for "truing up" the wheels of carriages and engines on railways. The apparatus is applied to a pair of wheels in the following manner:—one end of a connecting rod is attached by a stud to the outside bearing of each wheel below the axle, and the other ends of these rods are fastened to a horizontal bar parallel to the axle; on this bar a sliding bar composed of two parts moves, each of its outer ends being provided with a grinder or cutter, placed opposite to and in contact with the outer rim or tire of each wheel; the inner ends of this sliding bar are joined together by an eccentric pin passing through them, fastened on a horizontal wheel, which has its bearings on the under part of the horizontal bar; this wheel is turned by an endless band, from a small pulley on the axle of the running wheels. Motion being communicated to the horizontal wheel, it will, by means of the eccentric pin, cause the two parts of the sliding bar to move alternately a short space backwards and forwards, by which means the grinders on their outer ends will be caused to traverse from side to side of the tire of the wheels as they revolve, and thereby grind down any inequalities of the same.—*Ibid.*

UNIVERSAL CHUCK FOR TURNING AND BORING.

Alexander Stivens, of Manchester, engineer, for certain improvements in machinery or apparatus to be used as a universal chuck for turning and boring purposes. Enrolled at the Petty Bag Office, May 19. The patentee claims the peculiar and novel arrangement of apparatus constituting a universal chuck, without confining himself to the number, size, or dimensions of the levers working on the central boss.

The chuck is formed of two plates, viz., a front plate and a back plate, in the former of which are formed three radial mortices; the three holding nogs or dies are attached by screws to dove-tail slide-pieces, which slide backwards and forwards in the mortices. In one of these pieces a nut is formed, in which a screw works, its outer end being supported in a bearing on the edge of the front plate, so that on turning the screw round by means of a key applied to its outer end, the slide-piece will be made to traverse to and fro in its mortice. To each slide-piece is attached one end of a straight lever, the other ends of which levers are attached to an equilateral triangular lever, working loosely on the centre boss of the chuck; by this means, on the screw being turned, the slide-pieces will advance or recede simultaneously within their mortices.—*Ibid.*

IMPROVEMENTS IN DETACHING LOCOMOTIVE AND OTHER CARRIAGES.

Francis Pope, of Wolverhampton, Engineer, for improvements in detaching locomotive and other carriages. Enrollment Office, May 24. This invention consists of an ingenious piece of mechanism by which a horse can be instantly detached from the vehicle to which he is attached, or one carriage can be separated from another on railways. When applied to horse carriages, each shaft terminates in two iron side plates carrying a pin which form the axis of the shafts, and is the means by which they are attached to the carriage. There are also two side plates attached to the carriage, carrying a pin which forms the axis of motion to a bent lever or tongue; this tongue when turned back embraces the pin on the end of the shafts, and holds it securely in the recess formed for it. The tongue is held down by a peculiarly formed spring catch, to which a lever is affixed. So long as the tongue is held down by this catch, the shafts are securely held to the carriage, but on pulling the lever the catch is disengaged, the tongue flies over and the shafts and horse are released. When applied to railway carriages three of these attachments are employed, the centre one being a bar corresponding to the end of the shafts in the former case, and the two outer ones being chains. The three catches are simultaneously acted upon by an apparatus terminating in a handle which runs up to the seat of the guard. The claim is to the mode of constructing and applying apparatus as described.—*Mechanics' Magazine.*

CASE-HARDENING IRON.

Robert Roberts, of Bradford, Lancashire, Blacksmith, for a new method or process of case-hardening iron. Enrolled at the Petty Bag Office, May 25. This method consists in heating the iron and plunging it into cast iron in a state of fusion and turning it about, when it will become cased to any required thickness from $\frac{1}{16}$ to $\frac{1}{2}$ an inch, when it is to be plunged into cold water, and will then be found to be effectually case hardened. The claim is to the method or process of case-hardening iron, by coating, covering, or combining wrought iron with cast iron.—*Ibid.*

IMPROVEMENT IN PADDLE-WHEELS.

Henrry Charles Daubeny, Esq., Boulogne-sur-mer, France, for a certain invention or improvement in the making and forming of paddle-wheels, for the use of vessels propelled in the water by steam or other power, and applicable to propel vessels and mills. Enrollment Office, May 25. The floats are mounted on spindles or axes, one end of which work in a box or centre, the others in the circumference of the paddle-wheel. Near the ends of the spindles which works in the box, there are short levers which work against a traverse, so as to expose their broad surface to the water, while they enter and quit it edgeways. By this feathering operation, all the inconveniences arising from back water are obviated. In order to relieve the paddles from the effects of heavy seas, they are provided with an escapement consisting of two or more cogs let into the box of the wheel, and traversing round with it in a groove provided for that purpose in the flanch or carrier, fixed on the end of the main shaft; in this groove there are bridges which cause the cogs in passing them to throw up their front ends, and thus present their hind ends opposite to abutments formed in the face of the carrier, which, coming in contact with the hinder ends of the cogs, turn the paddle-wheel round. In the event of this wheel being struck by a heavy sea, the blow causes it to revolve faster than the carrier, and thereby relieves it from the injurious effects of the concussion. When the force of the sea is expended, the abutments again come in contact with the cogs, and the wheel is driven round by the effects of the engine. A mode of placing paddle-wheels in an inclined position is shown, by which means external projecting paddle-boxes are dispensed with.—*Ibid.*

IMPROVEMENTS IN STOPCOCKS.

Henry Bridge Cowell, of Lower-street, St. Mary's, Islington, Middlesex, ironmonger, for improvements in taps, to be used for or in the manner of stopcocks, for the purpose of drawing off and stopping the flow of fluids. Enrolled June 2, at the Roll's Chapel Office.

The first part of this invention consists in applying a moveable stopper to the spout of a tap, such stopper being suspended at the lower ends of two upright connecting links, one at each side of the spout, which link pass down through holes or sockets in the metal of the head of the tap. The upper ends of these links are connected to a piece of metal or collar, situated above the head, and fitted around a screw that turns in the same, so that on the screw being turned it will either rise or fall, and consequently raise or lower the stopper, thereby opening or shutting the spout of the tap. The fluid which escapes round the sides of the orifice of the spout on the stopper being lowered will be collected in the hollow mouth of the tap, so as to run out in a compact stream from the lower orifice.

The second part of this invention consists in applying to a ball-cock (similar in its parts to the tap just described) a second ball and lever, provided with a click or detent, having a tooth, which catches into a notch or notches cut in the circumference of an enlarged head on the end of the screw before mentioned. The click is mounted on a centre pin fixed in the collar of the screw, so that whenever the other ball descends the tooth catches into one of the notches, and turns back the screw, thereby opening the passage through the cock for the water. The usual ball is kept submerged during the flowing in of the water into the cistern, by means of the click preventing the screw to which it is attached from being turned; but when the surface of the water reaches the second ball, and raises the same upwards, the click will be lifted up about its centre of motion, so as to disengage its tooth from the notch in the head of the screw, whereupon the other ball will immediately rise to the top of the water by its power of floatation, and close the passage of the cock.

The third part of this invention consists of another kind of tap, similar in some respects to the one first described.—The moveable stopper is fitted in the manner of a piston into the cylindrical hollow of the head of the tap, so as to move up and down therein by the action of a screw working in a cap that surmounts the head of the tap; by turning this screw round, the stopper is pressed down on the upper orifice of the water-passage of the spout, and at the same time over the annular orifice of a circular channel formed within the head of the tap, and passing round the water-passage, through which channel the water is conveyed to the passage. Thus on depressing the stopper the flow of water will be stopped, but on raising the same the water will be permitted to flow again.—*Inventors' Advocate.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

February 23.—William Cubitt, V.P. in the Chair.

The following were balloted for and elected: Colonel Sir Frederick Smith, R.E., William Chadwick, John Bazley White, jun., Charles Lorimer Hensman, Joseph Whitworth, and Evan Hopkins, as Associates.

"*Description of a new mode of Steering, as applied to boats of light draught of water, navigating shallow and rapid rivers.*" By Captain Henderson, Assoc. Inst. C.E.

The ordinary method of steering with a single rudder, fixed in the usual manner, will bring a vessel round in about four times its length, upon an axis at the point of union between the dead wood of the vessel and the rudder. It was found desirable for the particular service on the Ganges and Burhampooter, for which the vessel in question was designed by the Assam Company, that great facility should be given for coming round rapidly; to accomplish this, the stem and stern of the vessel are alike provided with rudders, of a form adapted to the curvature of the craft. The stern rudder is considerably larger than the other, and occupies the space usually allotted to the dead wood, which is cut away; a more immediate influence is thus exerted upon the boat. The rudders are raised or lowered according to the draught of water, by means of capstans fixed upon the projecting ends of the shaft of a pinion, which is geared into a toothed racked of peculiar construction, on the back of each rudder post. The effect of this arrangement is, that the centre of revolution is transferred to a point nearer the centre of the vessel, and deviating from the true centre, in proportion to the relative dimensions, position and figure of the two rudders, and of the lines forward and abaft the vessel, which is thus brought round in little more than its own length.

The vessel, of which a model accompanied the paper, is fitted with condensing engines working expansively, with a pressure of steam of 20 lb. in the boiler; the cylinders are placed at an angle towards the paddle shafts, and act directly upon the cranks without the intervention of side levers.

"*Description of a Coffre Dam used in excavating Rock from the navigable Channel of the river Ribble.*" By David Stevenson.

The navigation of the river Ribble being much impeded by natural bars or weirs of sandstone rock, compact gravel, or loose sand, several ineffectual attempts were made to remove these hindrances, and eventually a joint stock company, called the Ribble Navigation Company, was formed for that purpose. Messrs. Robert Stevenson and Sons (of Edinburgh) were consulted, and under their directions the present works were commenced: their plan was to cut a channel in the rock wherever it was necessary, and to remove the gravel and sand by steam dredging, forming at the same time a low rubble wall upwards of a mile in length, for the purpose of directing the course of the river so as to obtain a permanent and straight navigable track for the shipping. The first of these operations is alone treated of in the communication.

About half a mile below Preston, a bed of sandstone rock, upwards of 300 yards in length, stretches quite across the river; some portions are entirely free from any deposit of sand or mud, and the higher parts are frequently left dry during the summer months. This natural weir exerts such an influence upon the flow of the tides, that neap tides which at 12 miles distance rise 14 feet, are not at all perceived at the quay at Preston.

It was proposed to cut a channel through this bar, 100 feet in breadth, affording an average navigable depth of 20 feet at high water of spring tides. In some places, therefore, the excavation would be 13 ft. 6 in. deep. After much consideration it was determined to make use of a series of coffre dams, as the most effectual and economical mode of proceeding. Their construction may be thus briefly described:—

A double row of wrought-iron bars, 2½ inches diameter, with *jumper* points worked upon them, were inserted vertically into the rock at regular intervals of 3 feet apart laterally, the second row being placed 3 feet behind the front row. When a sufficient number of bars were fixed, a tier of planking, 3 inches thick, with clasps to enable the planks to be fixed to the rods, was placed withinside. The lower edges of the planks were cut out roughly to the inequalities of the rock; they were then lowered, and by means of an iron rod, with a crooked end, those parts which did not touch the bottom were ascertained, and a change in the form made, until the plank rested its whole length on the rock: the lower edge was then bevelled off, and being finally lowered to its place, the plank was beaten down by the force of a heavy mallet, upon an upright piece of wood resting upon the upper edge of the planks; the lower bevelled edge yielding to the blows, sunk into the irregularities of the rock, and thus ultimately, in connexion with the puddle behind it, formed a perfectly water-tight joint. The lower planks being fixed, the upper ones were placed upon them; transverse tie bars were inserted at intervals; and the clay puddle was formed in the usual manner. In order that the navigation of the river should not be impeded, the diagonal stays were all placed inside the dams. These stays had joints at the upper ends, and being slipped over the tops of the iron rods, and kept in their places by cotters, their lower ends could be moved either horizontally or vertically, as the irregularity of the rock required:—as the excavation proceeded, longer stays were easily substituted, by merely removing the cotter, sliding up the short stay, and replacing it by another suited to the increased depth. The sides of the dam were kept together by bars of iron connected to two horizontal wale pieces, 10 inches by 6 inches, placed on the outside of the vertical iron rods. When the dam was thus constructed, the water was pumped out by a steam engine of 10 horses power, with two pumps of 12 inches diameter.

The whole of the excavation, which was 300 yards in length, and 100 feet in width, was to be completed with three lengths of coffre dams, so contrived as to include within the second stretch the lower side of the first dam, in order to excavate the rock in which that row of piles was fixed. The first and second lengths have been most successfully executed; the third is now in progress, and the excavation is proceeding very rapidly. The sandstone rock does not require gunpowder. The total quantity to be excavated is estimated at 31,000 cubic yards; all the stone which is raised is used in the construction of the wall for directing the course of the lower part of the river.

Some doubt existed in the mind of the engineer as to the security of the fastening of the iron rod piles by merely jumping them from 15 to 18 inches into the rock; they have, however, proved to be perfectly firm during heavy floods, when the whole dam has been submerged, and the velocity of the current which was rushing over it was not less than five miles per hour.

This paper was accompanied by two drawings, showing the general arrangement of the work, as well as the details of the construction of the coffre dam.

March 2.—The President in the Chair.

The following were balloted for and elected: Peter Hogg, Henry Oliver Robinson, Thomas Oldham, Edward Jones Biven, and Robert Ransome, as Associates.

"*On a new form of Railway Chairs and improved Fastenings.*" By Charles May, Assoc. Inst. C.E.

At the suggestion of Mr. Cubitt, V.P., a series of experiments was instituted at the works of Messrs. J. R. & A. Ransome, of Ipswich, for the purpose of determining the most advantageous form of the chairs, and most secure mode of fastening them upon the sleepers of the South Eastern Railway. The result of these experiments has been to produce the cast iron chairs, and wooden treenails as fastenings, which were exhibited at the meeting, and described by the author.

In the event of a chair breaking, it is desirable that the fracture should occur in such a manner as to prevent any of the loose pieces being thrown into situations where they would interfere with the passing trains; to ensure this, the weakest part of these chairs is across the seat—they are, however, stronger in that part than any other chair now in use. In order to ascertain the proper relative proportion between the strength of the jaw and that of the seat, many experiments were made by varying the forms, and wedging the chairs, until they broke, sometimes in one and at other times in the other part; it was then easy to add so much strength to the jaw as would, without waste of metal, cause the fracture to take place invariably across the seat.

For the purpose of ensuring perfect accuracy of form, with a smooth internal surface, so that wedges of a uniform shape and size might be used, the chairs are cast upon metal cores: the joint-chair has an upper piece, overlapping the wedge, to keep the rail in a perpendicular position, and to prevent the end of it from being thrown up or forced away laterally, if the wedge should accidentally be removed. This form of chair was originally planned by Mr. John Harris, the engineer of the Stockton and Darlington railway, where it has been in use above twelve months, giving perfect satisfaction. The rail is so placed in the intermediate chairs, that when it receives the pressure of the wedge, it is held firmly down on the seat, against the lower part of the jaw, and at the upper part against a slightly projecting rib, which bears against the neck of the rail.

The holes for the fastenings are so arranged as not to be in the same line; a large portion of the current expense of the maintenance of way on railroads arising from replacing the sleepers which have been split by the spikes being driven in the same line in the grain of the wood.

The mode of fastening adopted in this case is, to use treenails of dry English oak, compressed into two-thirds of their original bulk, by being forced under a fly press, into metal tubes, in which they are placed in a chamber heated to about 180°, where they remain 16 hours: the pressure upon the body of the treenail (the head not being compressed) is sufficient to materially increase the specific gravity without injuring the fibre, or diminishing the strength of the wood, and it retains the form thus given until it has been driven into a damp sleeper, when the expansion is sufficient to fix it firmly.

The ordinary mode of fastening chairs with iron spikes has been found disadvantageous, because one blow too many causes a reaction, and frequently loosens them, whilst treenails may be driven to any depth, and the heads subsequently split with small wedges if necessary.

Rails should be 'keyed-up' so tightly as to ensure security, still leaving a large amount of surplus strength in the chair to resist any shock to which they may be exposed:—with wedges of varying dimensions, the chairs, which are frequently of unequal quality, and carelessly cast, are liable to be brought nearly to the breaking point, and to give way as soon as they are subjected to any additional strain. This has been avoided in the chairs and wedges under consideration, by giving them exact uniformity of dimensions.

The wedges adopted are of English oak, cut out of square timber, so formed as to drive equally well with either side to the rail, and compressed into five-sixths of their bulk, by the same process as is used for the treenails.

Many advantages will result from this form of chair and wedge, with the treenails for fastening; the time occupied in laying the rails is diminished; the holes for the fastenings may be bored in the sleepers by machinery, at a diminished cost, and greater accuracy of gauge obtained at the same time; the required inclination of the rail being given in the chair, no cutting away of the sleeper is necessary; the sole of the chair is fixed horizontally upon the surface of the sleeper, and all of them may be placed accurately in the same plane, thus bringing to bear upon the hitherto roughly executed details of railway engineering, those mechanical contrivances by which the cost is diminished, whilst the dependance upon the skill and attention of the workmen is avoided; at the same time insuring the accuracy of the line, upon which so large a portion of the economy of working a railway depends.

Specimens of the chairs, wedges, and treenails, accompanied this communication.

Mr. Cubitt observed, that two modes of preparing treenails had been hitherto adopted: one was, by forcing the wood through a steel die, in which case neither the form nor the diminished bulk was preserved, as on leaving the die it swelled nearly to its original size. The other was by passing the wood between rollers: this latter process had been found to cause permanent injury to the fibre of the wood, by crushing the capillary tubes, and consequently depriving it of much of its strength. To the mode of preparing the treenails under consideration, neither of these objections existed. He anticipated many advantages from the use of this form of chair, wedge, and fastening. They would certainly be cheaper even in the first cost than the ordinary chairs, fastened down by iron spikes. The usual calculation for a double line of rail was 880*l.* per mile for the chairs, wedges, and spikes. The cost of these chairs, with the compressed wedges and treenails, would be 786*l.* per mile. The price of the compressed treenails for railway purposes would be 5*l.* 10*s.* per thousand; that of iron spikes was 6*l.* 5*s.* per thousand. The wedges 2¼ inches square, cost 2*l.* per thousand for each inch of their length, so that those for the joint-chairs, which are 8 inches long, average 16*l.*, and those for the intermediate chairs, of 6 inches long, cost about 12*l.* per thousand. Each joint-chair, with wedge and treenails, costs 2*s.* 10*d.*; and the intermediate ones, with their appendages, 2*s.* 1*d.* each.

One great cause of expense on railways was the fracture of the chairs during the laying. He knew an instance where in a length of 20 miles of railway 180 tons of chairs had been broken, either by wedging or in driving down the spikes. This was in the ratio of one chair in ten. In the ordinary mode the oak wedges are driven home by a 14 lb. sledge hammer, whereas with the new chair the compressed wedges and treenails are driven by a light wooden mallet.

Mr. Pim remarked that the wood fastenings used for the chairs on the Dublin and Kingston Railway had been compressed by rolling. He considered the present plan much superior.

Mr. Vignoles corroborated the statement of the cost of chairs of the ordinary construction. On the railways of the north of England oak treenails had been used as fastenings for a considerable period. The plan now proposed presented many advantages, not only in the construction of the chairs, which appeared well designed and excellently cast, but in the form and mode of preparation of both the wedges and the treenails.

In answer to a question from the President, whether the compressed treenails could be applied with advantage in ship building—Mr. Mills was of opinion they could be so employed, provided the fibre was not injured by the process. He believed that sound wooden treenails were better fastenings for ships than iron bolts, and quite as good as copper, whilst by their use the expense was materially reduced. Turned treenails of locust wood were at present preferred to all other kinds.

Mr. S. Seaward understood that, at the Royal Dockyards, treenails which were crooked as much as three times their own diameter were preferred to straight ones. He believed that the late Mr. H. Maudslay had constructed some machinery expressly for turning them crooked.

Mr. Hawkins remarked that the treenails were frequently crooked, because the rending caused them to follow the direction of the grain of the timber. Twenty-two years since, Mr. Annesley took out a patent for building ships without ribs. He used for fastenings, treenails compressed by being forced through steel dies, just before driving them into the planks, so that their expansion fixed them firmly in the planking. He built a vessel of very light construction, the sides of which were formed of five thicknesses of ¾-inch boards, held together by compressed treenails, without any ribs. It had proved very stiff and durable.

In reply to a question from Mr. Vignoles, whether the swelling of the compressed treenails in the ribs would not have the effect of preventing the possibility of the "butt end" of a plank starting—Mr. Mills believed that such an event was of rare occurrence; treenails were subjected more to a lateral strain; they were frequently "backed out" after the planks had been fitted into their places; when the latter were properly bent they retained their shape, and had no tendency to spring out.

Mr. S. Seaward, in support of the opinion that leaks did occur from planks starting, instanced the "Marquis of Huntly," East Indiaman, which was injured in the Downs, by a collision with another vessel; she proceeded on her way to China, but during the whole voyage out and home forty extra men were employed at the pumps. On being taken into dock, it was found that the "butt end" of one of the bow planks had started for 8 or 9 feet in length, and nothing but constant labour and attention had kept the ship afloat, at an expense of 7,000*l.* to the owners.

March 9.—The PRESIDENT in the Chair.

The following were balloted for and duly elected: Joel Spiller, as a Member; John Pope, as a Graduate; Thomas Routledge and Frederick Taylor, as Associates.

"*Description of a Bridge for a Railway crossing above a Turnpike Road, where the depth between the soffit of the Bridge and the surface of the Rails is limited, to twenty-one inches.*" By John Pope, Grad. Inst. C.E.

This bridge was designed by Mr. W. Cubitt, V.P., to meet the conditions of a clause in a Railway Bill, which required that there should be a clear width of opening for headway through the bridge in every part, 30 feet wide by 20 feet high, whilst at the same time the height of the embankment limited the space between the under side of the bridge and the surface of the rails to 21 inches.

The railway is carried on three cast iron girders, each 3 feet deep at the centre, diminishing to 6 inches at each end, with a bearing of 2 feet on cast iron wall-plates, supported by brickwork abutments. The flanches of the girders are 8 inches wide, and the metal every where 2 inches thick. Balks of Memel timber, 12 inches square, are laid transversely, close jointed, their ends bearing upon the flanches of the girders: on these timbers the chairs are fixed, and the rails are laid. The whole depth employed is—

The flanch of the girder	- -	2 inches
Thickness of timber balks	- - -	12 „
Depth of the rail and chair	- -	6½ „
		20½

One of the girders on each side supports the parapet wall in which it is completely encased, and being faced with cut stone, assumes the appearance of a flat camber arch, 3 feet in depth.

A detailed drawing, showing minutely the construction, accompanied this communication.

ARCHITECTURAL SOCIETY.

Conversazioné held Tuesday evening, the 1st of June, 1841, William Tite, Esq., President in the Chair.

After the report of the proceedings of the Society during the session was read, the President delivered a very interesting lecture, "*On the researches made in Egypt, at the expense and under the authority of the Tuscan Government.*" By Signor Rosillini. The lecture was illustrated by a variety of drawings, models, and valuable engravings, which very considerably enhanced its interest.

At the completion of the lecture the President announced the agreeable duty which he had to perform, in the distribution of the prizes which had been awarded by the Society for competition during the past session; at the same time he expressed his regret that the students had not been more active in the other classes of competition, and stated that although prizes had been offered by the Society for competition in the class of original design, in the class of measured drawings from a public building, and also for the best fairly transcribed notes of the Professor's lectures, yet it became his painful duty to state that no competition whatever had been attempted in either of these classes; neither was there any competition for the prize offered for the best drawing of the human figure from a plaster cast in the possession of the Society. Having made these observations, the President proceeded to the distribution of the two prizes which had been awarded, viz., to Mr. Arthur Johnson, for the greatest number of the most approved sketches from subjects given by the Architectural Society during the session 1840 and 1841; and to Mr. Frederick Johnstone, for having produced the best drawing from a plaster cast in the possession of the Architectural Society, session 1840 and 1841. The President called the attention of the meeting to some specimens of a patent which had been obtained for uniting lead and other metals without solder, which he was of opinion was worth the consideration of persons connected with building. He then announced that the business of the meeting, and of the session was concluded, and in so doing directed the attention of the visitors and other gentlemen present to the various specimens of art contributed for the evening's entertainment; among which was a very beautiful drawing, being a representation of the shield to be presented to Lord Eglinton, in commemoration of the late tournament held under his superintendance, both the design and drawing were by Mr. Henry Nixon. Also a newly invented ball-cock patented by Mr. Henry Abraham, the architect; likewise a cast in bronze of an elaborately chased Roman vase, together with sundry specimens of Roman tesselated pavement.

There was also exhibited a very beautiful model in plaster of Mr. Tite's (the President) portico of the New Royal Exchange, as approved and decided by the Gresham Committee, to be erected—it elicited considerable praise and attraction. There was another model of the New Church now erecting at Muswell Hill, under the direction of William Barnes, Esq. Also sundry models by Mr. Samuel Nixon, as well as numerous drawings by Henry Nixon, Clayton, G. B. Moore, Punnett, Meredith, William Barnes, G. Mair, William Grellier, William Nunn, &c. &c. The meeting was numerously attended, and was favoured by the presence of many of the leading and most scientific men of the day.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

June 7.—A paper was read by the Rev. R. Burgess, Hon. Member, on the Roman temples. Mr. Burgess traced, in a most interesting and entertaining narrative, the history of the temples of antiquity, from the rays encircling the heads of the heathen deities, originally applied as a protection to the heads of their statues, and the niches in which they were subsequently ensconced, down to the gorgeous edifices of the Roman empire.

June 21.—Mr. T. L. Donaldson, Fellow, read a description of the column erected at Petersburg in honour of the late Emperor Alexander. The construction of this monument rivals that of the best ages of antiquity. The shaft is monolithic, of polished granite, 84 feet in length. The pedestal is also a single block of the same material, and so carefully has the durability of the work been considered, that two vast masses were successively rejected after they had been extricated from the quarry as not being sufficiently perfect. Possessed as we are in Great Britain of granite quarries capable of supplying stones of almost unlimited dimensions, it is to be regretted that such an example should be lost upon the directors of our public works. Unfortunately the example is likely to excite nothing but feelings of horror and contempt for so outrageous a dereliction of the principles of economy!

A paper was afterwards read on the open roofs of the middle ages, by T. Morris, Esq.,—many examples were exhibited and described. It appeared to be the general opinion of the meeting, that the scientific skill displayed in these beautiful and picturesque combinations of timber work has been greatly over-rated. Some have signally failed, as at Eltham, while in others, as at Westminster Hall, the principle resolves itself, on examination, into the simplest elements of roofing. The durability of these structures seems rather due to the mechanical construction of the carpentry, in which they are worthy of the greatest admiration.

MESSRS. COOKE AND WHEATSTONE'S ELECTRIC TELEGRAPH.

(From the Railway Times.)

We have given many occasional notices of this admirable invention—of its adoption on the Great Western and Blackwall Railways, and its surprising performances in both instances—but it still remains to us to lay before our readers such a detailed account of the apparatus as may enable them to comprehend fully the mode of its operation, and to estimate duly its great practical efficiency. We cannot help thinking that it must be owing in a great measure to a prevailing paucity of information on the subject of the invention, that it is not making its way more rapidly into use, and believe we shall render good service to the railway interest by doing our best to make its value more clearly, distinctly and generally known. For the following descriptive details, and the numerous engravings by which they are illustrated, we are indebted partly to the evidence given by Professor Wheatstone before the Select Committee of the House of Commons on Railways, and partly to a set of drawings with explanatory letter-press recently published by the Professor's managing partner in the invention, Mr. Cooke. Some doubts it will be recollected were raised respecting the proportions in which Messrs. Wheatstone and Cooke divided between them the merit of the invention; but these doubts have been for ever removed by the statement on the subject which we published three or four weeks ago, drawn up at the mutual request, and (we believe) to the satisfaction, of these gentlemen, by their friends Sir I. Brunel and Professor Daniell.

Professor Wheatstone having been requested by the Committee of the House of Commons to explain to them the mode in which he proposed to communicate intelligence between two distant points, made the following answer:—

I have here a copy of the drawing of the specification to the first patent taken out by myself and Mr. Cooke; in all essential particulars, the instrument here represented resembles the one at the Great Western Railway. Here is what may be called a dial (see Fig. 1,) with five vertical magnetic needles. Upon this dial 20 letters of the alphabet are marked, and the various letters are indicated by the mutual convergence of two needles when they are caused to move; if the first needle turns to the right and the second to the left, H is indicated. If the first needle deviate to the right, and the fourth to the left, then B is indicated; if the same needles converge downwards, then V is pointed to. These magnetic needles are acted upon by electrical currents, passing through coils of wire placed immediately behind them; here is the representation of one of those coils, with the position of the magnetic needle with respect to it (Fig. 6). Each of the coils forms a portion of a communicating wire, which may extend to any distance whatever; these wires, at their termination, are connected with an apparatus, which may be called a communicator, (Fig. 1,) because by means of it the signals are communicated; it consists of five longitudinal and two transverse metal bars, fixed in a wooden frame; the latter are united to the two poles of a voltaic battery, and, in the ordinary condition of the instrument, have no metallic communication with the longitudinal bars, which are each immediately connected with a different wire of the line; on each of these longitudinal bars two stops are placed, forming together two parallel rows. When a stop of the upper row is pressed down, the bar upon which it is placed forms a metallic communication with the transverse bar below it, which is connected with one of the poles of the battery; and when one of the stops of the lower row is touched, another of the longitudinal bars forms a metallic communication with the other pole of the voltaic battery, and the current flows through the two wires connected with the longitudinal bars, to whatever distance they may be extended, passing up one and down the other, provided they be connected together at their opposite extremities, and affecting magnetic needles placed before the coils which are interposed in the circuit, there must be a similar complete apparatus at every different station.

"There is another very essential part of the apparatus I wish to mention, which is, the means we have of ringing a bell before the communication begins, in order to call the attention of the observer. The general principle of the alarum is this; to the detent of an alarum, on the ordinary construction of a clock alarum, a piece of soft iron is fixed, and opposite to it there is a bar of soft iron bent to the form of a horse-shoe; round this bent bar, wire, covered with silk, is wound, forming numerous coils; it is a property of soft iron to become powerfully magnetic when an electric current passes through a coil thus surrounding it. When the horse-shoe bar thus becomes magnetic, it therefore attracts the detent, and the bell immediately rings; when the current ceases the magnetic power ceases also, and the bell

Fig. 1.—Original Electric Telegraph.

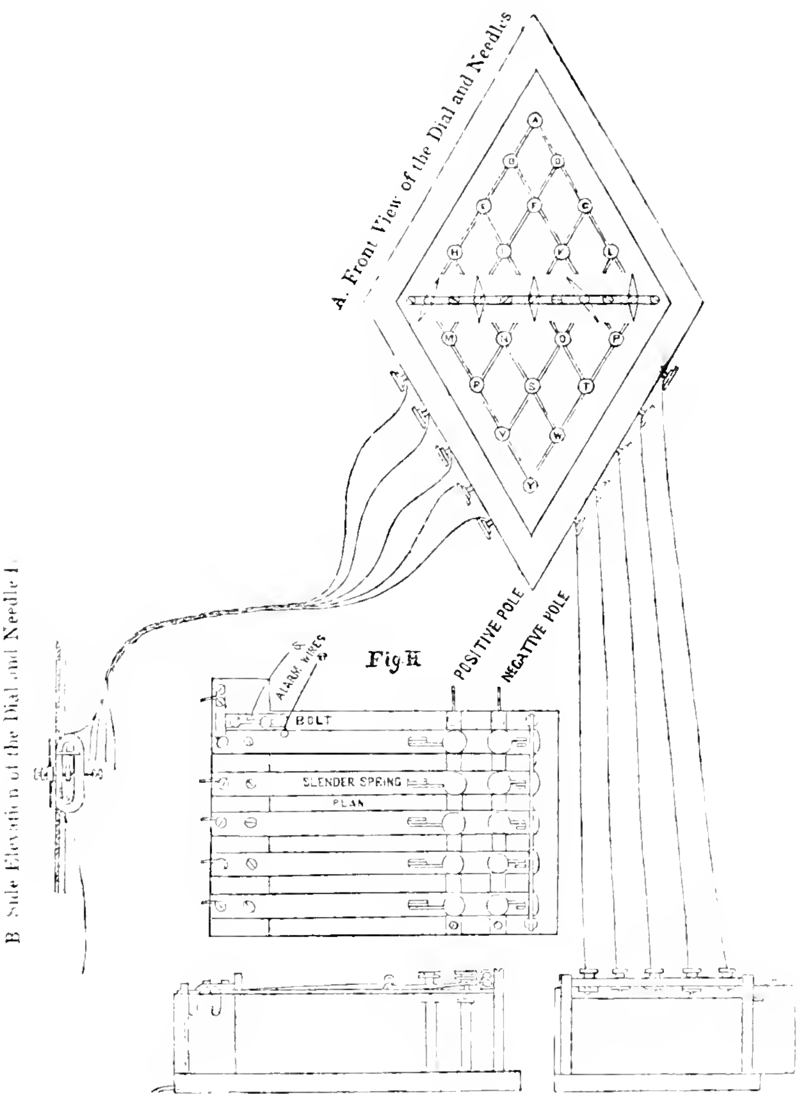
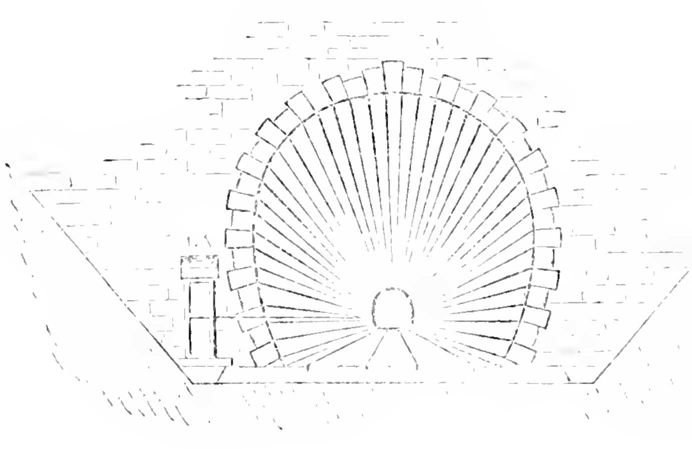


Fig. 2, Perspective view of a Tunnel



discontinues to ring. There are several other contrivances made to effect this purpose. Some other arrangements there are to which Mr. Cooke has particularly directed his attention, relating to the means of establishing communications at intermediate parts of the line where no fixed stations exist. To effect this, posts are placed at every quarter of a mile along the line, for the purpose of establishing a temporary communication with either of the adjacent stations; the guard of a train may thus carry with him a portable instrument, by means of which he can send up a message to a station either way, whenever it may be required. The wires are kept insulated from each other by a mixture of cotton and india rubber, which is a very good insulating material; then these prepared wires are all passed, with certain precautions, through an iron tube, which in some parts of the line is buried beneath the ground, and in other parts of the line is raised above it."

Lord Granville Somerset put this case:—"Suppose the Great Western Railway were completed between London and Bristol, do you contemplate the possibility of carrying your telegraph through the whole way, so as to signify from London to Bristol any thing you wish to communicate, and *vice versa* from Bristol to London?"—Professor Wheatstone replied, "The experiment has not been tried, but I have every reason to believe that it can be done. One very important circumstance I have ascertained is the little power requisite to produce this effect; it was formerly thought, that to send a current to any considerable extent very strong batteries must be employed, but in fact a very weak battery is sufficient, provided only it consist of a number of elements proportionate to the distance. So far as my experiments have gone, I think I should be able to effect a telegraphic communication between Bristol and London. Possibly several stations might be required, but, at any rate, the stations may be at far greater distances from each other than would be required for any ordinary system of telegraphs; my opinion is, that the intermediate stations will not be required."

Mr. Loch asked whether there was any appreciable loss of time in making a communication from the Paddington station to the extremity of the line to which the telegraph is now carried? Professor Wheatstone: "From some experiments I made some years ago, published in the *Philosophical Transactions*, when I first turned my attention to the possibility of effecting telegraphic communications, I ascertained that electricity travelled through a copper wire at the rate of about 200,000 miles in a second; consequently there is no appreciable time lost in the communication of the electrical effect; the only time that would be lost would be at relay stations, if they were necessary."

Chairman: "Could you communicate from Dover to Calais in that way?—I think it perfectly practicable."

Professor W. added the following observations:

"An electrical telegraph offers a great many advantages over an ordinary telegraph; it will work day and night, but an ordinary telegraph will act only during day; it will also work in all states of weather, an ordinary telegraph can only work in fine weather. There are a great number of days in the year in which no communication can be given by an ordinary telegraph, and besides, a great many communications are stopped before they can be finished, on account of changes in the state of the atmosphere. No inconveniences of this kind would attend the electrical telegraph. Another advantage is, that the expense of the separate stations is by no means comparable to that of the ordinary telegraph; no look-out men are required, and the apparatus may be worked in any room where there are persons to attend to it. There is another advantage the electric possesses over the ordinary telegraph, viz. the rapidity with which the signals may be made to follow each other. Thirty signals may be conveniently made in a minute; that number cannot be made by the ordinary telegraph. There is one thing I will take the opportunity to mention—I have been confining the attention of the Committee to the telegraph now working on the Great Western Railway, but having lately occupied myself in carrying into effect numerous improvements which have suggested themselves to me, I have, conjointly with Mr. Cooke, who has turned his attention greatly to the same subject, obtained a new patent for a telegraphic arrangement, which I think will present very great advantages over that which at present exists. It can be applied without entailing any additional expense of consequence to the line now laid down, it will only be necessary to substitute the new for the former instruments. This new apparatus requires only a single pair of wires to effect all which the present one does with five, so that three independent telegraphs may be immediately placed on the line of the Great Western; it presents in the same place all the letters of the alphabet according to any order of succession, and the apparatus is so extremely simple, that any person, without any previous acquaintance with it, can send a communication and read the answer."

Fig. 3, Longitudinal view of a Tunnel.

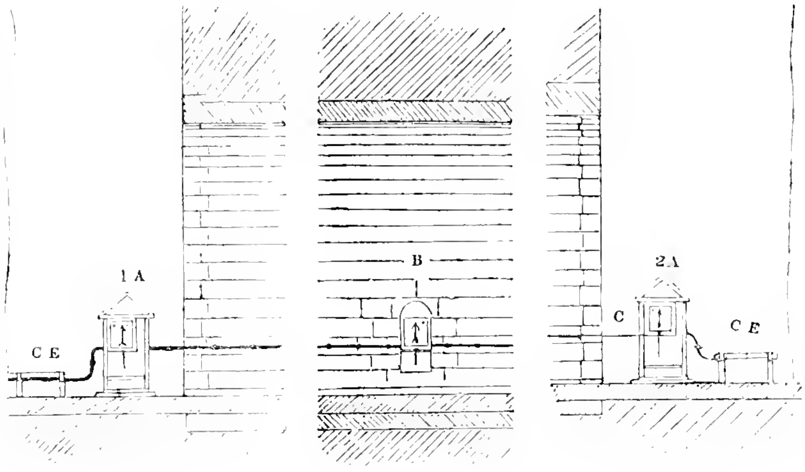
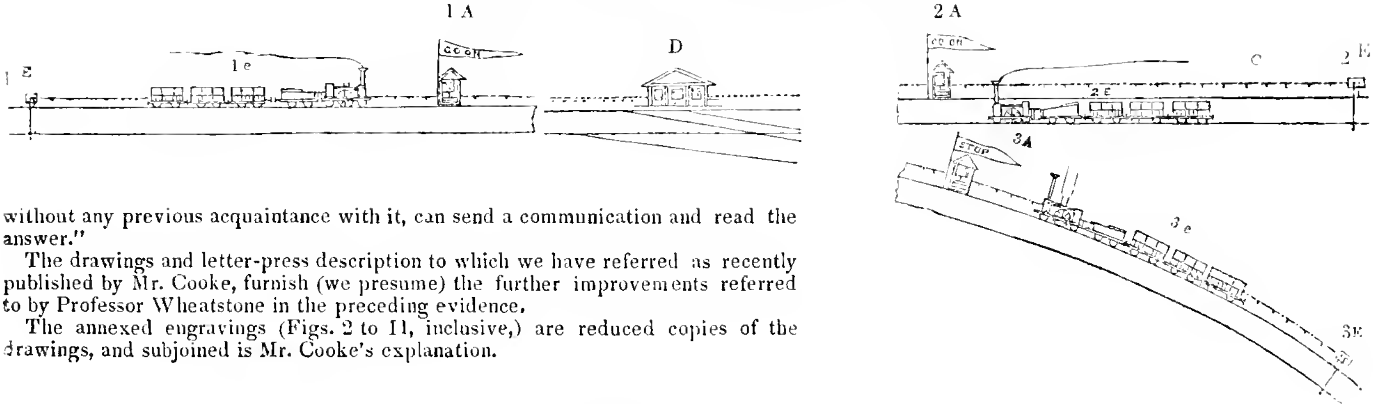


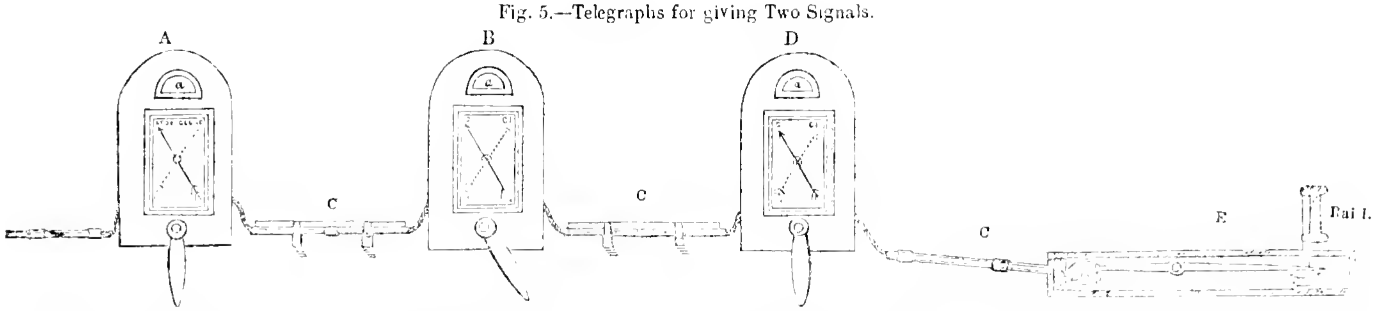
Fig. 4.—Application of the Telegraph to Crossings, &c.



The drawings and letter-press description to which we have referred as recently published by Mr. Cooke, furnish (we presume) the further improvements referred to by Professor Wheatstone in the preceding evidence.

The annexed engravings (Figs. 2 to 11, inclusive,) are reduced copies of the drawings, and subjoined is Mr. Cooke's explanation.

Fig. 5.—Telegraphs for giving Two Signals.



Figs. 2 and 3 show the application of the electric telegraph to tunnels.

1 A, 2 A. Telegraphs fixed in policemen's boxes near the entrances of tunnels.

B. Intermediate telegraph near a shaft within a tunnel, always ready to work with 1 A, 2 A, in case of need.

C. Protecting tube for conducting wires.

C E, C E. Tube leading to engine-warner; *vide* Figs. 4 and 5 with explanation.

Fig. 4. Application of the electric telegraph to level crossings, approaches to stations, and switches, &c.

1 A, 2 A, 3 A. Telegraphs fixed in policemen's boxes, one or two miles from a level crossing or station.

C. Protecting tube for the conducting of telegraph wires, either carried on posts with a railing over it or under ground.

D. Telegraphs at stations or level crossings, corresponding with 1 A, 2 A, 3 A.

1 E, 2 E, 3 E. "Engine-warners," (for details *vide* Figs. 5, 6, 7 and 8,) by which an engine gives notice of its approach, at the distance of one or two miles, both to A and D, Fig. 5. If the station or crossing be clear, D replies to the policeman at A to allow the train to "Go on," or else to "Stop," according to circumstances; the engine-man never venturing to pass A till the policeman has given the signal to "Go on." This will ensure the watchfulness of the policeman; but even in case of his absence, the conductor would inquire by the telegraph A for permission from D to proceed. In the figure, the policemen at 1 A, 2 A, Fig. 4, have received permission from D (as is indicated by the pointing of the handles of the telegraphs at D, corresponding with the indications on the telegraph both at D and 1 A, 2 A,) to allow their respective trains to proceed. The policeman notifies in the usual manner, by the white flag, or signal that the line is clear. The train 3 e had been stopped by the policeman at 3 A, in obedience to a signal from the station D, in reply to the "warning" given by the engine of its approach from 3 E.

N.B.—The signal given from the "engine-warner" E, at A and D, is "Stop," accompanied by the ringing of an alarum. This signal remains till answered from D.

Fig. 5.—Telegraphs for giving two signals, as represented above at A, B, and D, each having an alarum (a), which sounds when a signal is given either from E, D, A, or B.

Thirty-one telegraphs, giving two such signals, are working from eight in the morning till ten at night, on the Blackwall Railway, between the stations and the termini, to direct the working of the fixed engines.

E represents the details of the "engine-warner."

An upright bolt passes through one rail of the "approaching" line of road, the upper end rising slightly above the rail, so as to be depressed by an engine-wheel, or other very heavy body passing over it. The lower end of the

Terminal Telegraphs.

Fig. 6

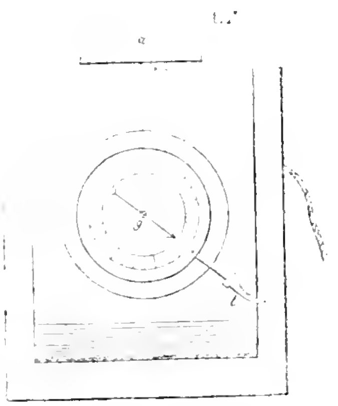
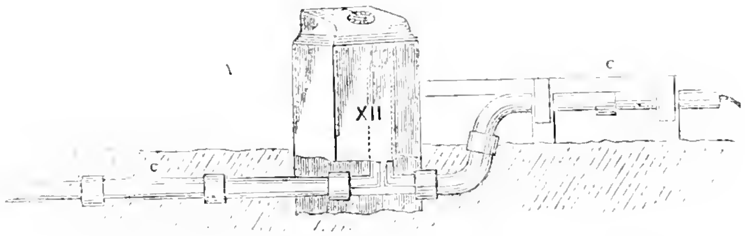
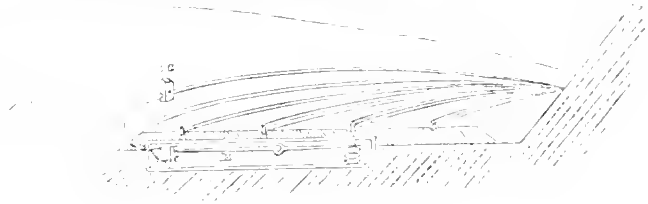


Fig. 7

Fig. 8. An Intermediate and Portable Telegraph.





Section of Railway.

Fig. 10. The Electric Detector, for detecting injury caused to the wires, &c.

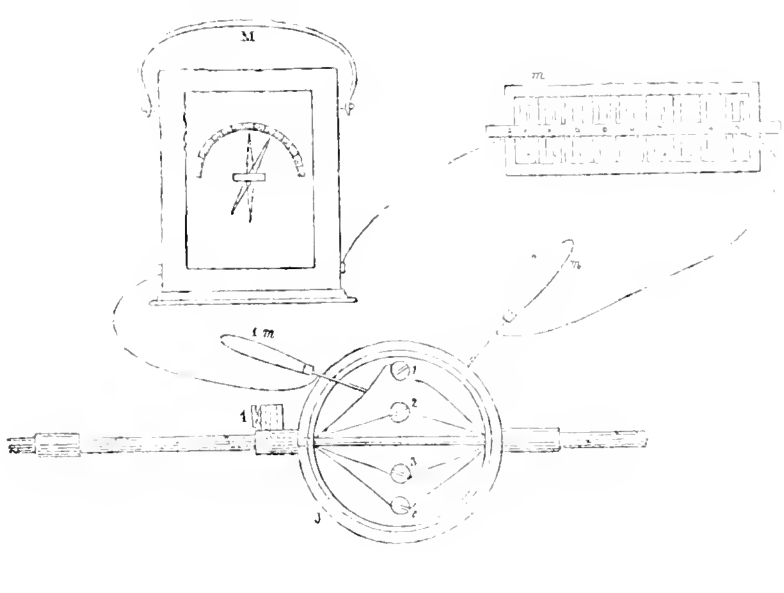
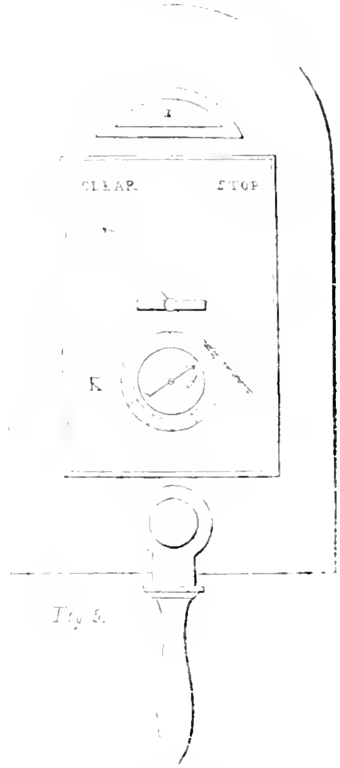


Fig. 9. Telegraph of a simple form.



bolt rests upon the arm of a lever supported by a spring capable of offering a resistance equal to at least half the pressure of one wheel of a carriage.

Upon a train passing, one arm of the lever is depressed, which, raising the other arm, breaks the electric circuit at e, and causes the alarum to be sounded and the warning signal to be given at A and D; the other wheels of the train produce no further effect till the warning has been replied to from D, which at the same time restores the electric circuit of the "warner" for another signal. Though the "warner" might be let off by mischievous persons with a crowbar, no inconvenience would be occasioned beyond arousing the expectation of the policeman for the time occupied by a train in passing the space between E and A, when the fact would be discovered, and reported by a signal to D. The object of the "warner" may obviously be attained by a variety of simple mechanical means.

Figs. 6 and 7.—Terminal telegraphs, for more extensive communications than those already described, giving 30 or 60 signals by the pointing of a revolving index-hand at letters on a fixed dial, as in a common clock; the person giving the signal turns the concentric hand *t*, till its pointer stands opposite the signal to be given, as shown in Fig. 6, when instantaneously, the index hand *g* in all the corresponding telegraphs in the circuit, viz. Figs. 6, 7, 8, &c. point at the same signal. Fig. 8 is an intermediate and portable telegraph, to be carried with each train, and applied, in case of need, to convenient arrangements at each mile-post or bridge along the line. The section of a railway below Fig. 8 illustrates this subject. An iron cap to the mile-post being unlocked and taken off, the portable telegraph is placed within a ledge fitted to receive it, making thereby the necessary connexions with the conducting wires, when it is at once fit for working with the "terminal telegraphs." This form of telegraph can be worked by any person at first sight, and requires no battery to be carried with it. It is fitted up with a water-proof cover and lantern, for rainy weather and night use.

N.B.—All forms of this electric telegraph are "reciprocal" in their action *i. e.* they give the same signals, in the working as in the recipient apparatus, and work equally from either end or from intermediate points.

Fig. 9 represents a very simple form of telegraph, on exactly the same principles as Figs. 5, 6, and 7, but combining the powers of both; the arrow giving two signals, for the purposes explained when applied to tunnels, level crossings, &c., and the small index K being adapted for a more extensive communication, when circumstances require it.

am prepared to support Mr. Cubitt's opinion of the effect of the weirs. I do not give any opinion of the proper mode of dealing with the peculiarities of the river Severn. I form my opinion on general scientific principles—that the effects described, by Mr. Cubitt will take place. I am now constructing sea walls where there will be a weir, but I have never constructed one across a river. The present weirs are of great length. I have heard of the mode in which it is proposed to construct them. I see no use for a foot frame in the present case. I think it will stand, as the stones are to be dropped in. I do not think the water will have any effect upon the stone so deposited. The pressure is removed to a great extent by the sheet piling. The water will go over the top of the sheet piling, and find its way through the stone works. It will perforate in a gentle manner, and not disturb the stone work. In flood there will be no fall at all, because it will be the same height above as below. I don't think I ever saw a large weir of this kind: I have seen small ones in canals, and I can apply the effect produced in other places to the present case. Many weirs in this country and others are formed simply by loose rubble stone. The finest I ever saw, which is on the Boyne, is so constructed. A weir of this description is made water-tight by the sheet piling above it. If it should slip I should pack it again with fresh stone; it would be little expense. I am getting packing done now at 6d. per yard for labour. The former stone would be available. I am aware of the object of putting the weirs across the river; it is for the purpose of getting a higher level above. It is placed obliquely, to afford greater facility for the passage of flood water. I am of opinion that it would. I have myself proposed it. It is now being done in the river Shannon. I am not engaged there, but I have made many experiments on the subject. When the weir is placed right across the river it diminishes the water way by the whole superficial area of the weir. It is the same when it is placed obliquely, until the water flows over. As soon as the water rises over the weir the circumstances are altered, and there would be less obstruction, in proportion to the length of the weir, when it is placed at right angles. The summer water would be at the same level, above and below, in either case. In time of floods the water comes down at all points of the weir at equal depth. It would always do so with an oblique, but not with a right angled one. I don't see any reason why, in an oblique weir, the water should make to the lower angle; it would pass down parallel with the axis of the river, or to the banks, if the banks are parallel. That is my deliberate opinion. This principle may be applied in all cases of flood. The water will not fall in the same manner, but will take the shortest line. If the water is rapid it will form an acute angle at the crown of the weir. I don't think water a foot deep will fall in this way. If you want to double the capacity of the weir you should more than double its length. If you did so with a weir directly across, you must widen the river.

Mr. Cubitt explained, that wherever he proposed to put a weir, if the river was not wider at that part than above and below, he proposed to widen the river at that part for the whole extent of the weir, to an extent at least equal to the cross section of the weir; the consequence of which would be, if they took the cross sections, the channel would amount to the sectional area, at least, to the section of the river above and below.

Mr. Mc'Neil's examination, resumed.—I have made experiments as to carrying a double quantity of water over a weir. I simply speak of the quantity passing over, not of its approach. Not knowing the river, I can say nothing about the dredging.

By Serjeant Wrangham.—I do not know how much it is intended by the Upton weir to pen up the water at the tail of the weir above. Whatever height of water is penned back above the present summer level at half a mile above Upton weir, will be so much abstracted from the water-way of the river. When the current passes over the weir, it will pass at a higher level than before the weir was there, by very nearly the depth of the water penned back by it, added to the depth of the column of water passing over the weir. In cases of flood the section of water-way for carrying off the flood will not be diminished to the extent of the water penned back, because the dam below is at the same time increasing in height, until it comes to the same level, when the weir becomes no weir at all. Supposing the water to be penned back within a few feet of the top of the bank, the river above being contracted, all the water that can pass will pass over the weir.

Re-examined by Mr. Serjeant Merewether.—The question just put to me relates solely to the capacity to retain, and not to obstructions and the facilities of avoiding them. The discharge of water over the weir will be in proportion to the length of the weir. I have heard of this principle for seven or eight years. The construction of the Breakwater in the Plymouth Sounds is the same as it is proposed to construct these weirs. I consider it to be the best mode of constructing weirs.—I have been professionally employed on many rivers. The weir on the Boyne stands very well. If the force of a river be five miles per hour, it would strike a weir directly across at the same force, but if the weir is oblique, the force which strikes against it is represented by a line drawn at right angles, and if the hypothenuse is five, the force that would strike that side would be nearly three. If a weir pens up five feet of water for a mile the water becomes stagnant, while it fills up to the weir; but if a fresh should come it would not produce any impediment to its passing over an oblique weir.

(To be continued.)

MISCELLANEA.

Daguerréotype Portraits.—A new discovery was communicated at the last sittings of both the Royal Society of London and the Institute of France in Paris, which is one of the most important improvements made in the Daguerréotype process, particularly when applied to the art of taking portraits. Mr. A. Claudet is the inventor of this discovery, which consists in the combination of chlorine, with the usual preparation. It is sufficient to expose the plate for one or two seconds to the vapours of that gas, to render it so sensitive to the effect of light, that the time of exposure in the camera obscura is shortened from 4 or 5 minutes to 10 or 15 seconds. This result must be of the greatest importance in taking likenesses, as the great difficulty in getting a person to sit immoveable for so long a period as was formerly required, always acted as a serious obstacle. Mr. A. Claudet is entitled to the warmest acknowledgments for his invaluable discovery, and for having been liberal enough to communicate it to the public. We understand that the inventor is carrying on his process at the Adelaide Gallery, and that his likenesses are exquisitely executed.

The Princess Royal Steam Pleasure Boat.—On Wednesday June 9th, this newly-built pleasure boat, propelled by the Archimedes screw, made her first pleasure trip from Brighton to Arundel and back. She was very recently built on the Tyne (under the direction of Messrs. Bass, W. Catt, jun., and Collins, the committee of the owners) from which port she arrived on the 8th June, in the short space of 48½ hours, the distance being upwards of 400 miles. She is of the following dimensions: length of keel 81 feet, breadth of beam 17½ feet, depth of hold 10 feet, of immersion 6½ feet, tonnage 101 tons register. There are two engines each of 23 horse power, the screw is 5 feet diameter, 6 feet pitch, and 34 strokes of the engine making 170 evolutions is the regulated speed. The velocity of the boat is about 8 knots an hour (equal to about 9¼ miles.)

Horsham.—The new church of St. Mark's (the first stone of which was laid in April 1840), was consecrated on the 3rd instant. It is in the early English style. The new school-room adjacent is also completed. Now the work is finished it is due to the architect, Mr. Mosely, and the builder, Mr. Darby, to say that both design and execution are highly creditable. Still, the continuation of the parapets the whole length of the building, and the adoption of stone in lieu of slate for the roof would have been decided improvements. Doubtless the *funds* influenced these matters. The church contains 900 sittings, and the cost, including gas fittings, boundary wall, and a few other extras, is less than £3500. It must, however, be stated that the ground was a gift, as was also the use of a stone quarry.

Faculty of Engineering in the University of Dublin.—The authorities of Dublin University seem to be anxious to aid in the present movement for extending instruction in the practical sciences, and have given notice of their intention to form a faculty of engineering in Trinity College. The faculties now are London, Durham, Glasgow and Dublin, and the schools Woolwich, Chatham, Sandhurst, Addiscombe, King's College, University College, Museum of Economic Geology, Putney, Durham College, Edinburgh Academy, Glasgow College, Dublin College, and the Mining School of the Royal Dublin Society.

Société des Architectes.—A Society of Architects is in progress of formation at Paris, on the model of the Institute here, which we hope it will worthily emulate.

Powers of Locomotive Steam.—A steam coach running at a moderate rate, which is about 21 miles per hour, would run over a distance of 500 miles per day of 24 hours, and at that speed would reach British India from London in about 8½ days—or Pekin in China in 11 days—or from Gibraltar to the Cape of Good Hope in 10 days—or from Quebec to Cape Horn in 17 days—or once round the globe in 51 days—or 7 times round the globe in one year—or a distance equal from the earth to the moon in about 16 months, or from the earth to the sun in 500 years.—*Greenock paper.*

Pompeii.—A search among the ruins of Pompeii, which took place lately led to the discovery of a marble statue, a silver vase, and a quantity of gold, silver, and bronze medals, in a good state of preservation.

Locomotive for Common Roads.—A gentleman residing at Southwell, Dr. Calvert, has constructed a machine, which he purposes to call "The *Alternate*," because he rides or walks in turn according to the ascending or descending inclination of the road he travels. By merely rising from his seat, and throwing part of the weight of the body upon the hands placed on a guiding bar, he *walks* with less fatigue than he could do without the machine, especially where the ascent is not very steep. On descending he sits down and *rides* at his ease with considerable speed. The propelling action (the most powerful that can be exerted, and one of the most lasting is that of rowing. *Nottingham Journal.*

Paper from Asparagus.—We have pleasure in hearing that one of the most famous paper manufacturers, M. Dierecks, of Ghent, has collected all the stalks of asparagus that come from the tables d'hôte and great houses of the town, in order to convert them into paper. Every evening two or three loads of these fibrous stalks are carried to the rolling mill, and thence to the stamping machine, which triturates them in the course of a few hours. The kind of paste which is thus produced does not require bleaching. It is put into a tub, and taken to the paper-making machine, from which it issues converted into excellent white paper, the expense of which is not half that of paper made from rags. We have no doubt that when this secret is once known, it will be eagerly appropriated by all large manufacturers. Asparagus mixed with the pulp of beet-root produces a kind of paper, which is even superior. —*La Fanal.*

A Steam Organ.—M. Lax, jun., has just invented a steam organ, which can be heard through the extent of a whole province. This instrument, consisting of vibrating plates of metal, is so regulated that it is acted on by steam of four or five atmospheres of pressure. These plates are merely very large steel bars, which can only be made to vibrate by very high pressure steam. This monster organ is fitted for popular solemnities and inaugurations of railroads. It may be placed upon a wagon in front of the engine, which will supply it with the same steam that moves the piston in the cylinders. The sound of this stupendous instrument would overpower the noise of the issuing steam, the working of the wheels, and the roaring of thunder.—*Le Fanal.*

Rope-making in America.—Mr. Buckingham gives the following description of the rope manufactory at Boston. "The ropewalk of the navy-yard is one of the finest I ever remember to have seen. It is nearly half a mile in length, two stories in height; it is built entirely of the same beautiful granite as that used in the construction of the dry dock, and is roofed with iron and slate. The window shutters are all cased with iron, and the whole is rendered fire-proof. Some very recent and excellent improvements have been introduced into the machinery here, by a native American engineer, Mr. Treadwell, by which a steam engine at one end of the building is made to furnish the requisite power for performing all the operations for rope-making, with very little aid from the labour of men, from the first combing of the hemp, and spinning it into threads, to the tarring and twisting the yarn, and the winding of the whole into the hawser or the cable required. I had seen some of the best ropewalks in England, both in the royal dock-yards, and in the private establishments of London, and other parts, but I remember nothing equal to this of Boston, either in the beauty and perfection of the building and the machinery, or the admirable uniformity of strain in every strand and every fibre in the rope produced; or the finished roundness, smoothness and flexibility of the hawsers and cables, of which several were submitted to our examination, both in progress and completed."

Steam Navigation on the Meuse.—One of the new steam-boats intended for the Liegeian Company of Navigation, was last week launched in the Meuse. It was towed as far as the railway to Val-Benoit, in order to put in the boiler. Without the boiler, and with the engine alone, the draught of water of the boat was 21 centimetres (8 inches); with the boiler it is 25 centimetres (10 inches). The engine, which is a low-pressure one, and according to the Jackson plan, weighs only 2,400 kilogrammes. It was constructed in the manufactory of Messrs. Derosne, Cail, and Co., at Charenton, near Paris. Excepting in England and on the Loire, there are not yet any engines like it. The engines of the steam-boats which were in operation last year on the Meuse, were considerably heavier. The vessel which has just been launched is 3 metres and 50 centimetres (11 feet) in depth, and 36 metres and 50 centimetres (118 feet) long. Every thing on deck is nearly finished, and it will soon be able to commence working. Great progress is made in the construction of the second vessel, and it will be ready for service in a short time after the first. It is estimated that the draught of these boats, with their load of fuel, will not exceed 35 centimetres (14 inches), while that of the former boats amounted to nearly 60 centimetres (24 inches); we are, therefore, induced to hope that steam navigation, unless when the waters are excessively low, may henceforth be generally adopted on the Meuse.—Another steam-boat of iron is now constructing in the manufactory of M. Petry, an engineer, at Grevegnée-les-Liége. Persons experienced in the art of boat-building, who have had opportunities of seeing this fine vessel, consider that the country has not produced any equal to it.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 27TH MAY, TO 25TH JUNE, 1841.

Six Months allowed for Enrolment.

George Bent Ollivant and Adam Howard, of Manchester, millwrights, for "*certain improvements in cylindrical printing machinery for printing calicoes and other fabrics, and in the apparatus connected therewith, which is also applicable to other useful purposes.*"—Sealed June 5.

John Mee, of Leicester, framesmith, for "*improvements in the manufacture of looped fabrics.*"—June 5.

William Hannis Taylor, of Lambeth, Esq., for "*certain improvements in propelling machinery.*"—June 5.

Joseph Gibbs, of the Oval, Kennington, civil engineer, for "*certain improvements in roads and railways, and in the means of propelling carriages thereon.*"—June 5.

Miles Berry, of Chancery-lane, patent agent, for "*certain improvements in machinery or apparatus for ruling paper.*" (A communication.—June 5.

James Colley March, of Barnstaple, surgeon, for "*certain improved means of producing heat from the combustion of certain kinds of fuel.*"—June 8.

Henry Richardson Fanshaw, the younger, of Hatfield-street, Surrey, chemist, for "*improvements in curing hides and skins, and in tanning, washing, and cleaning hides, skins, and other matters.*"—June 10.

John George Bodmer, of Manchester, engineer, for "*certain improvements in machinery for propelling vessels on water, parts of which improvements apply also to steam engines to be employed on land.*"—June 10.

Edward Hammond Bentall, of Heybridge, Essex, iron-founder, for "*certain improvements in ploughs.*"—June 10.

Robert Oram, of Salford, Lancaster, engineer, for "*certain improvements in hydraulic presses.*"—June 12.

James Wiles Wayte, of the "Morning Advertiser" office, Fleet-street, engineer, for "*certain improvements in machinery or apparatus for letter-press printing.*"—June 12.

John Anthony Tielens, of Fenchurch-street, merchant, for "*improvements in machinery or apparatus for knitting.*" (A communication.)—June 12.

George Claudius Ash, of Broad-street, Golden-square, dentist, for "*improvements in apparatus for fastening candles in candlesticks.*"—June 12.

Edward Palmer, of Newgate-street, gentleman, for "*improvements in producing printing surfaces, and in the printing china, pottery, ware, music, maps, and portraits.*"—June 12.

Ezekiel Jones, of Stockport, mechanic, for "*certain improvements in machinery for prepairing slubbing, roving, spinning, and doubling cotton, silk, wool, worsted, flax, and other fibrous substances.*"—June 12.

Alexander Horatio Simpson, of New Palace-yard, Westminster, gentleman, Peter Hunter Irvin, and Thomas Eugene Irvin, both of Charles-street, Hatton-garden, philosophical instrument makers, for "*an improved mode of producing light, and of manufacturing apparatus for the diffusion of light.*"—June 17.

Thomas Walker, of North Shields, engineer, for "*improvements in steam engines.*"—June 18.

William Petrie, of Croydon, gentleman, for "*improvements in obtaining mechanical power, which are also applicable for obtaining rapid motion.*"—June 19.

John Haughton, of Liverpool, clerk, master of arts, for "*improvements in the method of affixing certain labels.*"—June 19.

James Henry Shaw, of Charlotte-street, Blackfriars, jeweller, for "*improvements in setting wheat and other seeds.*"—June 19.

Sir Samuel Brown, knight, of Netherbyers-house, Ayton, Berwick, for "*improvements in the means of drawing or moving carriages and other machines along inclined planes, railways, and other roads, and for drawing or propelling vessels in canals, rivers, and other navigable waters.*"—June 19.

John George Truscott Campbell, of Lambeth-hill, Upper Thames-street, grocer, for "*improvements in propelling vessels.*"—June 19.

Joseph Gauci, of North-crescent, Bedford-square, artist, and Alexander Bain, of Wigmore-street, Cavendish-square, mechanist, for "*improvements in inkstands and inkholders.*"—June 21.

Miles Berry, of Chancery-lane, patent agent, for "*a new or improved engine, machine, or apparatus for producing or obtaining motive power by means of gases or vapours produced by combustion.*"—June 23.

William Walker, the elder, of Standish-street, Liverpool, watch-finisher, for "*an improvement or improvements in the manufacture of the detached lever watch.*"—June 23.

George Thomas Day, of Upper Belgrave-place, Pimlico, gentleman, for "*an improved apparatus for creating draft applicable to chimneys and other purposes.*"—June 23.

John Henry Le Keux, of Southampton-street, Pentonville, for "*an improvement in line engraving, and in producing impressions therefrom.*"—June 23; two months.

John Goodwin, of Cumberland-street, Hackney-road, piano-forte maker, for "*an improved construction of piano-fortes of certain descriptions.*"—June 23; two months.

James Sidebottom, of Waterside, Derby, manufacturer, for "*certain improvements in machinery for apparatus.*"—June 23.

William Chesterman, of Burford, Oxford, gentleman, for "*improvements in filtering liquids.*"—June 23.

Robert Stephenson, of Great George-street, Westminster, civil engineer, for "*certain improvements in the arrangement and combination of the parts of steam engines of the sort commonly called locomotive engines.*"—June 23.

John Lee Stevens, of King Edward-street, Southwark, general agent, and John King, of College Hill, printer, for "*certain improvements in candlesticks and other candle holders.*"—June 25.

TO CORRESPONDENTS.

Mr. Mushet's papers; and Mr. Davies and Mr. Ryder's reply to Mr. Perkins' answer, that appeared in last month's Journal, were not received until the latter part of the month, they will appear in the next Journal.

M. Q.'s communication will appear next month—tracings will be returned when required.

"The Mammoth" is to be worked by the Screw, unless new orders have been lately given to the contrary.

We must beg of our American correspondents not to forward Pamphlets by Post, we have had several demands upon us for 5s. and 6s. postage for each.

A lengthened abstract of Mr. Hood's excellent paper "on the Properties and Chemical Constitution of Coal," has already been given in the Journal, and the paper besides has appeared in another periodical.

Works received and will be noticed next month—Mr. Ranken's Patent Wood Pavement, Report on "the Improvement of the Navigation of the Forth betwixt Stirling and Alloa." "Irish Railways." Mr. Sopwith's description of Geological Models, and Mr. Williams's work on the Combustion of Coal, 2nd edition.

Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

ERRATA.

In Mr. Clark's communication "*On the Action of Central Forces,*" in the last month's Journal, page 182, 2nd column, 31st line from bottom, for $A_0^B C - A B$, read $A C = A B$. And page 183, column one, line 29, for $x = \frac{v^2}{r}$ read, $x \doteq \frac{v^2}{r}$.

the lateral cut is shorter here than the others, it is about 14 or 15 chains or 350 yards, the lift is 7 ft. 6 in. the dimensions are the same as the others, the length of the weir is 350 feet, the height from the bed of the river is about 11 ft. 6 in., the width of the river is from 100 to 130 feet. This takes us up to Red Stone Rock, and Cloth House, and to Stourport; the weir is to be in the cut there and the lock in the river, because the towing path is on the eastern side of the river, and we should have to pass over if we put a lock in the cut: I can't give the height of this weir. We dredge between Gloucester and Upton, because the shoals fall so much less in this district and are of a different character; they are shoals of deposit formed by the inequality of the sectional area of the channel. The shoals above Upton are hard beds of gravel and marl, which pen the water over in the summer season. The effect of dredging from Upton to Worcester would be to increase the liability of the banks to tumble in, and would also be inconvenient to the trader from the increased height of the banks, which are already too high; the same effect would be produced in a greater degree by dredging Upton shoal, unless there was something above. Compared with the present plan, dredging would be much more expensive, supposing it formed part of a continuous plan up to Stourport. If you removed the lock from Upton and put it at Diglis, you must have a double lift there, which would be inconvenient to the trade, as in point of fact it would be two locks. The extent of dredging in such a case must be to the extent of from 7 to 10 feet, which would be a serious matter, and would make cataracts from the locks. By the system of weirs we shall have 6 feet of water at all times from Stourport to Gloucester, which I believe would be sufficient for all purposes of trade on the Severn; I do not think it would be more than necessary for the canal boats. The build of vessels would alter if the water were deeper. In my opinion the trade of the river will be increased if these improvements are carried into effect. In my opinion if the maximum toll is imposed, these advantages will counterbalance it to the trade; I found that opinion upon the excessive delays, cost of lightering, pilferage, wear and tear, the increased power required to draw vessels up, the limited number of voyages and the light cargoes, which exist at present. The trade of Gloucester has suffered much in consequence, and has gone to other ports; to my knowledge many cargoes which, but for this, would have gone to Gloucester, have gone to Liverpool: this has been especially the case lately. I believe also that railways have increased the prejudice to the Severn. The cost of these improvements I estimate at £150,000, which will be sufficient, and more than suffice, and include contingencies, which I have estimated at 10 per cent. I am prepared to state in detail how it will be expended.

Cross-examined by Mr. Austin.

The original plan was made by Mr. Rhodes. I have been acting under Mr. Cubitt since Nov. 1825. I consider the merit or demerit of the present plan belongs to him. Mr. Cubitt was employed as consulting engineer, and Mr. Rhodes as acting engineer. I was employed by the committee of the late Severn Navigation Company. This is not the same plan as theirs, but the same with some alterations. Their plan was first made in 1838. There was a plan and sections. The original plan is at the Guildhall at Worcester. I have a reduced copy of it as altered. I took part in the formation of the original plan. It was adopted and altered by Mr. Cubitt. I said the deposit of shoals would depend on the drifts of the river. The river is divided in the plan into districts. The area of the first is at Upton, 3480 feet. That supposes a line drawn at the top of the bank and the bed of the river. The width is 104 feet, the average depth 11 feet. The next district is half a mile lower down, and has the same area; width 101 feet, average depth 10 ft. 6 in. The third is, area 3126 ft. width 98 ft. depth 11 ft. The fourth is, area 3101 ft. width 104 ft. depth 10 ft. 9 in. The fifth is, area 3529 ft. width 107 ft. depth 12 ft. The first section is half a mile below the Barley House, the second a mile ditto, the third a mile and half ditto, the fourth two miles ditto, and the fifth two miles and half ditto. That gives an average of 100 feet width and 10 feet depth, which is plenty of water for the necessities of the trade. There are no shoals there. When the water rises it expands also. The fall from Upton to Gloucester is about 7 inches, or 2·8 inches per mile. We propose to alter the whole river from Upton to Gloucester, to assimilate it at this part, and to maintain an uniform depth of 6 feet. The width of the river varies from 150 feet to 170 feet. I am not now prepared to give the Committee the detail of the cost of the works. Mr. Provis made the original calculation of the expense. The average dredging of the whole line will be less than 5 feet. The general estimate of the present plan was made by Mr. Cubitt at Worcester, in the autumn of last year. We had not a detailed estimate until within the last two months. I do not know that it is determined to lay down a quantity of rubble stone to be used between Upton and Gloucester. The depth of the water at the Upton weir immediately above is 7 feet, and below, 3 ft. 7 in. We propose to use the stuff dredged up in equalizing the width. Mr. Provis took the price of the stone from me. It was from 3*s.* to 3*s.* 6*d.* per yard, delivered not at the spot, but on the Severn. Part of it comes from between Worcester and Stourport, and the other part from Malvern. I can't tell the cost of the stone and timber between Worcester and Upton. We propose to coffer-dam at Bevere Island. The soundings for the shoals were under my direction. The borings were in many instances from 8 feet to 10 feet. Maisemore shoal was not bored, it being out of the direct line. We bored all the other shoals. We took 26 borings in the Worcester shoal.

By Mr. Serjeant Wrangham.—I do not know the quantity of work to be done for the purpose of improving the navigation. It will be a work of considerable amount to get a depth of five feet at Deerhurst shoal with a width of from forty to sixty feet. The dredge below Upton Lock will be on an average of from 4 to 5 feet for the same width for the length of a mile. I believe these excavations will not depress the level of water because they are shoals of deposit and not natural formations, and there is no fall from them. By dredging to Worcester you would be making the river a succession of rapids; if we deepened to a sufficient extent in low summer water we should get rid of the rapids, but we should lower the ponds above: it would do so even with the same sectional area. By narrowing the banks and increasing the depth the stream would flow faster: the shoals do not pen the water back except where it acts as a natural dam. From Diglis lock to Upton weir the total depth is 4 ft. 6 in.; this space contains a great number of rapids; the fall is 1½ inches per mile, with a soft bottom, but with a shoal of hard gravel and marl. I think that dredging up to Upton would not retain the level; there would be a diminution at Diglis lock of 3 ft. 9 in. by dredging, if the water was not penned back by our lock: that would leave a fall of 9 inches from Diglis lock to Upton. The river is not so broad from Diglis to Upton as below Upton; and being so, the fall above is greater than the fall below, but it must not be naturally so; it depends upon the inclination of the bed of the river, and the quantity of water carried. Many rivers, particularly the Thames and the Kennett, have had their navigation improved by artificial means. The current of the Thames is much faster than in the Severn. The velocity of the flood of the Severn is from 2½ to 3 miles per hour. Mr. Provis can give you a more satisfactory answer than I, as to the force with which that would strike our weirs. I have seen a portion of the surface of the weirs in the Thames washed off by the water. They are made in a very simple way—by piles, filled up. Our weirs will be much stronger than the Thames. During the six years I have been engaged on the Severn my attention has been particularly directed to these subjects, and the information I have given to the committee is the result of that investigation. Mr. Provis was called in about two months since. I have made a calculation of the time at which the river may become free again; and taking all things into consideration, I think it may become a free river again in forty years, with the exception simply of a toll for keeping the works in repair. My estimate applies itself to the cost of tonnage. I am sure I furnished Mr. Cubitt and Mr. Provis with sufficient information to give an opinion on the subject. The time now lost in consequence of the shoals is much greater than will be lost in going through the locks. The impediments to the navigation of the river now are much greater than can possibly exist under the improvements. I have passed vessels through the locks on the Thames in 3½ minutes; about 5 minutes is a fair average. Supposing a boat to start to Gloucester in a fresh, which, before the alteration, could get back in the same fresh, it would have greater facillty for doing so in consequence of the improvement of the river, notwithstanding the locks.

Mr. Provis, Engineer, examined by Mr. Serjeant Merewether:—I have executed works for Mr. Cubitt, and other engineers. The Menai Bridge was one of those works. The Birmingham Junction Canal was another, and I am now employed on works to the amount of £60,000 or £70,000. I was called in to give an estimate for the proposed works on the Severn, and Mr. Williams and I went down the river from Gloucester to Stourport, and I made my own observations in addition to the information given me by Mr. Williams. I have an estimate of the whole cost of the works, including 10 per cent. upon the cost of the works for contingencies, but exclusive of the land to be taken, which I do not pretend to value. The amount of that estimate is £133,108 12*s.* 3*d.*, being £121,007 16*s.* 7*d.* for the total cost of the works, and £12,100 15*s.* 7*d.* for contingencies. I have made such a calculation that, if the work were offered to me, I should have no objection to undertake it at that contract, providing the supervision was such as I liked. Were I employed as an engineer to examine that estimate, I should say that it is a fair sum to give to any man to do the required work. The cutting required at Upton will cost £4656 17*s.* 6*d.*; the lock at Upton (including the building, the gates, and every thing necessary to complete it,) £6321 4*s.* 2*d.*; the weir at Upton, (including all that is necessary, rubble stone, &c.) £3887. [It was here understood that the odd shillings and pence should be left out to simplify the statement.] This would make the total expense at Upton £14.865. Worcester, cutting £4210, lock £6231, weir £2848; total £13.379. Bevere: cutting £1082, lock and coffer dam (which I think will be required there) £10,768, weir £1569; total £13,421. Holt Fleet: cutting £3347, lock £5863, weir £1658; total £10,869. Lincombe Hill: cutting £5126, locks and dams (not coffer-dams but embankments) £8072, weir £2016; total £15,214. Total of the five totals £67,750. The five lock-houses will cost £1250. This includes all the work except the equalisation and works below Upton. The total dredging will cost £18,141. Protecting the sides of the river, £33,866. These two items make £52,007. The three totals make £121,000. With the best judgment I can form, I think this is sufficient for the work. I have made estimates to the amount of millions.

Cross-examined by Mr. Austin.—The quantity to be dredged between Upton and Gloucester, including both branches of the river, is 311,000 yards, which I estimate at 1*s.* per yard. I believe that to be the full price, and I include the taking away and depositing the soil, the whole of which is proposed to be used in narrowing the river. There is no intention to take any away, except, perhaps, throwing a little into some of the deep holes, and putting some of the best gravel on the towing paths, which are very bad. This work, will come to £15,500, which is a very large proportion of the total cost of dredging, leaving only £3000 more to be expended on dredging between Upton and Stourport. It is proposed to face the channel with rubble stone, at an inclination of 3 to 1, extending from the bottom of the dredged channel to the height marked in the section to represent the spring-tide level. There will be 193,520 square yards of rubble stone facing between Upton and Gloucester, or about 132,000 cubic yards, at 3*s.* 6*d.* per square yard, or 5*s.* 3*d.* per cubic yard. The stone can be procured at the Red Stone Rock, at Lincombe Hill, and at Holt Fleet. The mode in which the facing is to be done, is first to set the dredging machine at work, and then to throw the stone promiscuously into the channel, marks being set up for the guidance of the men who discharge the cargoes of stone. The rubble stone facing was my suggestion, and Mr. Cubitt has adopted it. I cannot tell how much sand or how much gravel will have to be dredged above Upton, as the quantity of dredging is so very small that I did not consider it worth while to examine very minutely. It would be a little harder to dredge stones than gravel, but not much, because if the stones were large we should remove the buckets from the machine and replace them with claws, which would take up detached stones. I estimate the excavation at 10*d.* per yard, which includes the removal of the soil, placing it behind the stone walls, and sloping it from the top. We shall be drawn to the plan of dropping in the stones for the weir till they rise to the surface, when they will be placed by hand, except where we make a cut, and then all the stones will be laid by hand. At the foot of the weirs it is proposed to have rubble stone, sloping at an angle of 3 to 1. We propose to make our weirs water-tight by having the sheet-piling jointed and grooved, and, as it will be driven comparatively dry, the swelling of the wood when it comes in contact with the water will be quite enough to make every joint water-tight. We do not resort to puddling. I have not made any estimate of the cost of the land which will be taken, nor for any compensation in case the drainage is affected. I have only estimated the cost of facing one side of the river at any place. This estimate has been in progress two months. I have not made any alteration in it from the first, saving to correct some little mistake respecting the quantities.

Re-examined by Serjeant Merewether.—The reason why I use stone instead of dwarf piling is because it is more durable than timber, and more proper to be used; but if it became a question, and it was deemed desirable to use timber in any particular part, then I should adopt timber. There are localities near the river where we can get stone very easily. The price I have stated is quite sufficient to cover any difference in the nature of the soil to be dredged. In constructing a weir we first put in piling. I have no reason to apprehend that the stone will be carried away, because there will be a great mass of it, placed at a considerable slope; I think the weirs will be quite strong enough to resist all pressure. I have not made any of these weirs myself, but I have taken drawings of some which have well answered the purpose for which they were designed. The walls are of the same description as those adopted by me in the river Dee, which is a rapid river. My cross-examination does not shake my conviction in the least, as to the strength of the wall.

Mr. Cubitt examined by Mr. Serjeant Merewether. The following are the principal items of his evidence:—Our plan will not affect the drainage below Upton at all, and will be the best with reference to expense. The dredging at Maisemore will be so small that the effect of it upon the Gloucester channel will be inappreciable. We shall dredge in the deep water channel. The plan proposed above Worcester has been adopted because in that district our object can be better and cheaper attained by it and with less injury to the surrounding lands. As an explanation of this, six inches of water going over a weir 600 feet long would take all the summer water in the Severn; 25 inches over a weir so constructed would make a good navigation and effect a good drainage of the land, and before injury could ensue the weir would become obsolete. We seek a channel of 45 feet from Upton to Diglis, with a rise at three inches per mile. The amount of dredging here would be upwards of 300,000 cubic yards, at 1*s.* per yard, which would be £15,000, which is the price of all the works at Upton. The lift between Worcester and Upton Bridge must be the sum of two lifts. If the two falls be brought to Worcester there must be two locks at the double fall, which would be more expense, in addition to the cost of £15,000 for dredging. I therefore think this is a sufficient reason why the weirs and locks should begin at Worcester. I apprehend there will be no difficulty whatever in the works answering their purpose when made. In putting the weirs across the river quite square it becomes a dead stop in proportion to the height and width of the weir to a portion of the section of the river, and backs up the water; but the quantity of water that falls over the weir is never of a longer sheet than the breadth of the weir, so that were the banks full there must be an obstruction. An oblique weir is the simplest, cheapest, and most efficient to dam up the river without injury. [To elucidate this, Mr. Cubitt produced a model of the proposed works and explained them in detail to the Committee, and also the scientific principles on which they were adopted.] I have considered the point of the sluices in the weir. I think them inexpedient. The flood gates would have no perceptible effect in such a case; and flood gates, as such, in the weirs would cost more than the weirs themselves. The weir is quite as capable of penning off the water without flood gates as with them.—If any works are put to improve Lord Sandys' drain it would not impede the navigation. My object has been to raise all the works, towing paths, &c., above the floods.—I do not intend to dredge away the quantity Mr. Provis stated at Maisemore shoal, or to do more to it than will be necessary to let the Maisemore boat pass. There is more in the Parliamentary sections than is necessary to be done, and so far there is a greater degree of safety.—I was first employed to make observations on this river by Mr. Lea, the Chairman of the Association at Worcester. I made my report to Lord Hatherton, the Chairman of the Committee of the Severn Association. I had met Mr. Williams professionally before. I was engaged with Mr. Rhodes in the plan of 1836; that was a plan involving the erection of weirs above and below Gloucester; the weir below Gloucester would have been in a portion of the river now avoided by the Gloucester and Berkeley Canal. The plans of the present day are the same amended; I approved of them in general, but not in all things. I have no doubt that we might get six feet of water by dredging up to Worcester, but it would be much more expensive. It is proposed to place a wall where we dredge. I have estimated for eight miles of walling and dredging; that will answer the double purpose of narrowing the river and securing the banks.

Mr. Cubitt cross-examined by Mr. Wortley.—Mr. Williams correctly described the mode of laying down the rubble stone. At one time I proposed to use dwarf piling in some places; and I still intend to do so, where I think it will be as cheap and efficient. In some respects it is preferable to stone, in others it is not so. I can't mention any part of the river in which I think it will be preferable. I do not propose to make the slopes of the banks perfect in all places, as Mr. Provis did, because I think there will not be stuff enough to do it. The channel of the Deerhurst shoal is rather straight; the deepest water is towards the left bank going down. It is not absolutely necessary to stone up to the high-water mark. The length of the dredging on the river between Upton and Gloucester upon my scheme, as marked on the sections, is between eight and nine miles. I should remark, that it is marked deeper than will be necessary for the navigation. I do not contemplate any works below the Gloucester and Berkeley Canal, nor below the entrance to the Gloucester and Hereford Canal. The continuous length of dredging in the sections, from Upton to Diglis is nine miles. We propose to start from Upton at a depth of 7 ft. 6 in.; and we do so because I don't think 6 feet sufficient. By the 6 feet spoken of as the depth we seek, I mean 6 feet above the lock sills. I save all the dredging there by penning the banks. Were we to dredge from Gloucester to Worcester to a width of 45 feet at the bottom, to the level of the lock sill of the Gloucester and Berkeley Canal, 5 feet in depth, with a slope of two to one, and rising 3 inches per mile, the quantity to be dredged would be 323,133 cubic yards. [Witness then answered a series of questions as to the volume of water that would flow in channels of different widths.] We shall scarcely affect the fall below Upton. We propose at Upton to form a close jointed waterproof weir, slanting, 600 feet long, with timber pilings drawn into the river, 10 feet apart; behind this we propose to drop stones into the river, without masonry. The expense of having the lock at Diglis, instead of Upton, would be very much increased on account of the additional fall. In some places where we construct our weirs we widen the river, in which cases the cross sections would be as great or greater than at present. I measured that section across the river at right angles to the stream. The height of the water above the weir is 6 inches. I know by principle, and partly by practice, that when the water is 2 feet above the weir the boats will go over. The water, in coming to the weir, does not diminish its velocity, and no more water would pass over the weir in consequence of its being oblique than if it were right angled. I do not make a pond, and therefore I do not cause a deposit. If you do any thing to diminish the velocity of the water coming through the weir it will tend to form a deposit; but if it be so constructed that the water coming through can keep moving on with the same velocity, it will have no more tendency to form a deposit than before the weir was put in. If I were to carry out the works at once I do not intend to make any alteration in the length of the weir; and if I did so at all, it would be to meet the views of others rather than my own convictions. If the river be increased beyond its natural width it will be more liable to deposits. The expenses of general maintenance of the works can never cease while the works exist. The expense of the navigation of the Ayr and Caldwell is very considerable. We do not alter the natural surface of the water at Diglis locks to any extent; if the weir were placed above the entrance to the canal, vessels would have the same depth of water. The reason I have for not placing it higher up the stream is that it would lengthen the cut very much, take more land, and much reduce the water to what I may call the harbour of Worcester. The length to the harbour is 1000 yards; it would increase the length of the cut about nine chains. There would be great passing of vessels from all places at the point, and therefore I think there should be a good harbour. If the vessels coming at the same time had to wait for the lockage, it would be the best place to wait in, but there would be little or no waiting, as they would pass the lock in three or four minutes. At Bevere Island I propose to put the weir below the mouth of the Salwarp; Mr. Rhodes in his last plan has placed it in the same place. By putting a weir in a shallow stream we raise the water; but the instant it gets so much above the weir as to lose a fall, from that instant the weir is no obstruction. I have had but little experience in salmon rivers; I understand there are good salmon in the Severn, and I should be very sorry to do anything to destroy them; I have nothing to do with how far these works will affect the rights of piscary; I have considered how to form the weirs so as not to obstruct the salmon in passing up the river; the weirs will not afford any facility for taking the fish. The average yield of the river at low summer water is from 40 to 60,000 cubic feet per minute above the Avon; the quantity of course differs below the Avon.

By Mr. Lowndes.—I have not personally taken the levels of the drains on the river Severn; I received information from Mr. Williams, and a great deal from Mr. Rhodes; I don't know that Mr. Rhodes personally took the levels. I received the greatest information on this point from the documents. I examined the drain on Lord Sandys' property myself; if you proved there was an under-drain there it would not matter on atom. I consider the sole operation of a drain to be to take the water off the surface of the land; the effect of an under-drain is to take off that which gets below the surface of the land. If there is an under-ground drain it does not follow that the level must be the same as that of the open drain. I do not know whether there is an under-ground drain at this place, but I believe all the drains on Lord Sandys' property come into the Severn below the weir.—When a fresh comes down the river the surface of the river will remain nearly the same as before the weir was put in. The works will raise the water on the river at Salwarp perhaps four feet. The value of the land to be taken will be proved hereafter by other witnesses. If it should be proved that 2000 acres for instance would be injured in their drainage by the bill, there has been no estimate made of the amount of compensation for that. I can't give any opinion as to the permanency of any damage that might ensue. I admit that the consequences of imperfect drainage would be to effect the atmosphere of the district. The state of the towing paths is not good; they give way on both sides of the river. When they have given way, it is generally the case that the land is encroached upon for a fresh one, which they are entitled to do. If they are entitled by their Act to take 10 feet on the side of the river, and that falls in, I am of opinion they can take 10 feet more; notwithstanding this, I do not think it is imprudent in us to undertake their management.

Mr. McNeil examined by Mr. Serjeant Merewether.—I am a civil engineer, and have been engaged in many extensive works for a period of 20 years. I have been present during the last few days of this enquiry. I have been engaged in works of a similar description to the present. Having heard the plan, I think it would effect the desired object. I think it would be best to dredge up to Upton. I think, also, that the weirs will effect Mr. Cubitt's object. With reference to expense, I think it is the best mode that could be adopted. I think the explanation given by Mr. Cubitt has been so clear, that nothing remains to be added to it.

Cross-examined by Mr. Austin.—I was called in on this business on Monday week. I had not made a previous examination of the river Severn. I never did so. I have been across it at Chepstow, but never practically examined it. I do not know any other river of a similar natural character. I under what circumstances, so awful a catastrophe would have occurred, of course not even those best acquainted with the subject could pretend to describe. Mr. Cottingham has caused about 150 wagon-loads of rubbish to be removed from the tower in order fully to ascertain its state, and there can be no doubt that the measures he intends to adopt will give full security. One great advantage, too, of his plans will be to expose the 52 stone columns of the tower (a remarkably fine piece of masonry) to the view of persons in the church. In the mean time, so imminent does he consider the danger, that he will not suffer the bells to be rung, and all attention to the other parts of the works is suspended until satisfactory reparation has been made. The restoration will now be effected at a comparatively trifling expense; had the discovery not thus timely taken place, the cost would have been enormous. It is worthy of remark that so little were these subjects understood only a comparatively short period ago, that the western front was declared to be secured for hundreds of years, and yet in six weeks only from the time of that declaration it was a mass of ruins.—*Hereford Journal.*

LIVERPOOL DOCKS.

It will be recollected that in the last February number of the Journal, we gave a letter of Mr. Hartley's, the Dock Surveyor, addressed to the Liverpool Dock Committee, in consequence of certain charges being brought against him by a Member of the Committee, whereupon a Sub-Committee was appointed to inquire into the charges. This Committee have lately made their report which is now before us, we are happy to announce, what we feel assured the whole of the profession were prepared for, that it completely vindicates Mr. Hartley from the charges. The report is too long for insertion in our Journal, but the following announcement we are sure will be all that is necessary for us to give.

"The sub-committee, having personally examined the accounts at the Dockyard, and the system of checks on labour and expenditure of stores, are unanimously of opinion, after a very strict investigation of the stock accounts, and careful examination of the books, which show in detail the expenses incurred in every department of work, and making allowance for the expense of the establishment and maintenance of a large stock, that the various works have been executed on very reasonable terms, and at lower rates than they could have been in any other way. The interests of the Dock Trust, in the conduct and management of the mechanical departments of the Surveyor's establishment, have been materially promoted by the system which has been pursued; and, as long as that system is kept up in the same orderly, vigorous, and efficient manner, no better system can be devised for the general benefit of the trust, the establishment being highly creditable to the Dock Surveyor, *whose indefatigable zeal, honour, and industry cannot be too highly commended.*"

Removal of Sunderland Light House.—At a late meeting of the Commissioners of the river Wear, the taking down of the Light House being discussed, as part of the plan of building the new North pier at the mouth of the harbour, Mr. Murray, the engineer, suggested the removal of the Light House, in its present entire state, to the eastern extremity of the new Pier, a distance of about 420 feet, so as to make it serve the double purpose of a stationary and a tide-light. Mr. Murray exhibited a model of the building, and after explaining how he proposed to effect this undertaking, the Board decided that he should proceed forthwith to remove it. This Light House was erected about 40 years ago, by the late Mr. Pickernell, then engineer to the Harbour Commissioners. It is wholly composed of stone; its form is octagonal, 15 feet in breadth across its base, 62 feet in height from the surface of the pier to the top of the cornice, where it is 9 feet in breadth across, and the top of the dome is 16 feet above the cornice, making a total height of 78 feet; and its calculated weight is 250 tons. Mr. Murray intends to cut through the masonry near its foundation, and insert whole timbers, one after another, through the building, and extending 7 feet beyond it. Above and at right angles to them, another tier of timbers is to be inserted in like manner, so as to make the cradle or base a square of 29 feet; and this cradle is to be supported upon bearers, with about 250 wheels of 6 inches diameter, intended to traverse on 6 lines of railway to be laid on the new Pier for that purpose. The shaft of the Light House is to be tied together with bands, and its eight sides are to be supported with timber braces from the cradle upwards to the cornice. The cradle is to be drawn and pushed forward by powerful screws, along the railway above mentioned, on the principle of Morton's patent slip for the repairing of vessels. However surprising the removal of such a building may appear to many, yet in New York, for some years past, large houses have been removed from their original situation to a considerable distance, without sustaining any injury. The immense block of granite, serving as the pedestal of the equestrian statue of Peter the Great, at St. Petersburgh, was conveyed four miles by land, and thirteen by water. Several Obelisks have likewise been transported at different times from Egypt to Europe; and lately, one was conveyed from Thebes, and erected by the French at Paris. But the fact that the Light House on our North Pier is composed of stones of comparatively small dimension, its great height, and small base, make the operation of removing it much more difficult than any thing of the sort ever attempted. We heartily wish the enterprising engineer every success in his bold and novel undertaking, which is to be carried into execution in the course of a few weeks from this date.—*Sunderland Herald.*

COMPETITION FOR THE MARSEILLES EXCHANGE.

The following conditions of competition for designing an Exchange at Marseilles, we have translated from *Revue Générale de L'Architecture.*

1st. The situation will be chosen in a *perimètre* commencing at the "Rue de la Prison," and proceeding up to the "Place de Justice," the Grand Rue as far as the Courts.

2nd. The competition designs must contain, not only the Exchange strictly so called, but also the Chamber and Tribunal of Commerce, the syndicat of the money-changers, the royal brokers, the merchant counsel, and all the necessary appendages to these, such as peristyle porticos, vestibules, vestries secretary's office, registry office, bureaux, counting houses, &c. &c. Also a dwelling place for the porter, a guard-house for a detachment, and a place to deposit cloaks, umbrellas, and walking sticks.

3rd. The great hall of the Exchange, including the interior porticos must contain at least 3000 persons, and consequently have a superficies of not less than 1000 square metres.

4th. The drawings must be done with care, the sections to be in a pale colour, the horizontal sections in Indian ink, and carmine for the vertical sections, yellow for the wood, Prussian blue for the iron, grey for the metallic roofs, and brick red for the tile roofs.

5th. Each design must be composed of the following separate pieces.

1. An explanatory and justifiable report.
2. A general plan of the whole.
3. A plan of the ground floors at one or two metres above the level of the great hall, and the same of the first floor.
4. Longitudinal and a transverse section through the interior of the edifice.
5. Front and back elevations.
6. Profiles and details of execution (this need not be paid so much attention to).
7. A descriptive device containing a scale of the works, and the cost after the current price of the country; the whole exactly and summarily expressed.

6th. As to the order of architecture, the best in whatever order it may happen to be chosen, and even the several orders may be blended, but keeping at the same time a tone of convenience, solidity, elegance, good taste, a noble simplicity, and a wise economy.

7th. The scale of the general plan to be, 2 millimetres to a metre, that of the sections and separate plans a centimetre to a metre, and that of the details of execution 5 centimetres to a metre.

8th. The competition is fixed at six months date from the 1st April. During the following fortnight the competitors to deposit their designs at the secretary's office, at the Chamber of Commerce, where they will receive a certain number according to the order of presentation, the names and address of the competitors must be enclosed in an envelope carefully closed, to which the same number will be affixed. Each competitor to have a receipt stating the formal deposition, the number of plans, and the particular number given them, but without indicating name or person.

9th. When the term for the preparation of the plans has expired, the designs will be submitted to the judgment of a committee chosen from the members of the Chamber of Commerce, and an equal number of artists. The decision will not be definitive until the sanction of competent authorities be given, and then the names only of the authors of the three best designs will be announced.

10th. The first design will receive the prize of 3000 francs (120*l*.), and then, without further remuneration or honours, will remain the property of the Chamber, who will have the right to alter it at their will, and to confide the execution to whom they please. The names of the other two authors of the second and third best designs will be honourably mentioned.

11th. Every design (No. 1 excepted), will be restored to their authors, as well as the sealed envelopes containing their names, on the production of the previously delivered receipts.

Marseilles, March 30, 1841.

CANAL STEAMER FITTED WITH MR. P. TAYLOR'S REVOLVING SCREW PROPELLERS.

On Wednesday the 5th of May, we had the pleasure of inspecting a new steam boat on the river Irwell, fitted by Messrs. Peter Taylor and Co., of Hollinwood, near Manchester, with steam engines and propellers of an entirely new construction, both inventions of Mr. Peter Taylor, and for which he has obtained patents. The vessel is 75 feet long and 10 feet wide, and built (with the exception of the gunwale and paddle-box,) entirely of iron. She appeared to perform very satisfactorily; at a speed varying according to the depth of water from about eight to nine miles per hour, which upon a confined water we believe has never been attained by any steam vessel. In noticing a trial some months ago of another vessel belonging to Messrs. Taylor and Co., which had then been newly fitted with similar propellers, we gave a description of the apparatus, which consists of a number of continuous curved vanes or segments of screws, or wings on two axes. In the instance now under notice five pairs are affixed upon one axis, and five pairs upon the other; the number being regulated by, and varied according to, the power of

Rope-making in America.—Mr. Buckingham gives the following description of the rope manufactory at Boston. "The ropewalk of the navy-yard is one of the finest I ever remember to have seen. It is nearly half a mile in length, two stories in height; it is built entirely of the same beautiful granite as that used in the construction of the dry dock, and is roofed with iron and slate. The window shutters are all cased with iron, and the whole is rendered fire-proof. Some very recent and excellent improvements have been introduced into the machinery here, by a native American engineer, Mr. Treadwell, by which a steam engine at one end of the building is made to furnish the requisite power for performing all the operations for rope-making, with very little aid from the labour of men, from the first combing of the hemp, and spinning it into threads, to the tarring and twisting the yarn, and the winding of the whole into the hawser or the cable required. I had seen some of the best ropewalks in England, both in the royal dock-yards, and in the private establishments of London, and other parts, but I remember nothing equal to this of Boston, either in the beauty and perfection of the building and the machinery, or the admirable uniformity of strain in every strand and every fibre in the rope produced; or the finished roundness, smoothness and flexibility of the hawsers and cables, of which several were submitted to our examination, both in progress and completed."

Steam Navigation on the Meuse.—One of the new steam-boats intended for the Liegeian Company of Navigation, was last week launched in the Meuse. It was towed as far as the railway to Val-Benoit, in order to put in the boiler. Without the boiler, and with the engine alone, the draught of water of the boat was 21 centimetres (8 inches); with the boiler it is 25 centimetres (10 inches). The engine, which is a low-pressure one, and according to the Jackson plan, weighs only 2,400 kilogrammes. It was constructed in the manufactory of Messrs. Derosne, Cail, and Co., at Charenton, near Paris. Excepting in England and on the Loire, there are not yet any engines like it. The engines of the steam-boats which were in operation last year on the Meuse, were considerably heavier. The vessel which has just been launched is 3 metres and 50 centimetres (11 feet) in depth, and 36 metres and 50 centimetres (118 feet) long. Every thing on deck is nearly finished, and it will soon be able to commence working. Great progress is made in the construction of the second vessel, and it will be ready for service in a short time after the first. It is estimated that the draught of these boats, with their load of fuel, will not exceed 35 centimetres (14 inches), while that of the former boats amounted to nearly 60 centimetres (24 inches); we are, therefore, induced to hope that steam navigation, unless when the waters are excessively low, may henceforth be generally adopted on the Meuse.—Another steam-boat of iron is now constructing in the manufactory of M. Petry, an engineer, at Grevegnée-les-Liége. Persons experienced in the art of boat-building, who have had opportunities of seeing this fine vessel, consider that the country has not produced any equal to it.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 27TH MAY, TO 25TH JUNE, 1841.

Six Months allowed for Enrolment.

GEORGE BENT OLLIVANT and ADAM HOWARD, of Manchester, millwrights, for "*certain improvements in cylindrical printing machinery for printing calicoes and other fabrics, and in the apparatus connected therewith, which is also applicable to other useful purposes.*"—Sealed June 5.

JOHN MEE, of Leicester, framesmith, for "*improvements in the manufacture of looped fabrics.*"—June 5.

WILLIAM HANNIS TAYLOR, of Lambeth, Esq., for "*certain improvements in propelling machinery.*"—June 5.

JOSEPH GIBBS, of the Oval, Kennington, civil engineer, for "*certain improvements in roads and railways, and in the means of propelling carriages thereon.*"—June 5.

MILES BERRY, of Chancery-lane, patent agent, for "*certain improvements in machinery or apparatus for ruling paper.*" (A communication.—June 5.

JAMES COLLEY MARCH, of Barnstaple, surgeon, for "*certain improved means of producing heat from the combustion of certain kinds of fuel.*"—June 8.

HENRY RICHARDSON FANSHAW, the younger, of Hatfield-street, Surrey, chemist, for "*improvements in curing hides and skins, and in tanning, washing, and cleaning hides, skins, and other matters.*"—June 10.

JOHN GEORGE BODMER, of Manchester, engineer, for "*certain improvements in machinery for propelling vessels on water, parts of which improvements apply also to steam engines to be employed on land.*"—June 10.

EDWARD HAMMOND BENTALL, of Heybridge, Essex, iron-founder, for "*certain improvements in ploughs.*"—June 10.

ROBERT ORAM, of Salford, Lancaster, engineer, for "*certain improvements in hydraulic presses.*"—June 12.

JAMES WILLS WAYTE, of the "Morning Advertiser" office, Fleet-street, engineer, for "*certain improvements in machinery or apparatus for letter-press printing.*"—June 12.

JOHN ANTHONY TIELENS, of Fenchurch-street, merchant, for "*improvements in machinery or apparatus for knitting.*" (A communication.)—June 12.

GEORGE CLAUDIUS ASH, of Broad-street, Golden-square, dentist, for "*improvements in apparatus for fastening candles in candlesticks.*"—June 12.

EDWARD PALMER, of Newgate-street, gentleman, for "*improvements in producing printing surfaces, and in the printing china, pottery, ware, music, maps, and portraits.*"—June 12.

EZEKIEL JONES, of Stockport, mechanic, for "*certain improvements in machinery for prepairing slubbing, roving, spinning, and doubling cotton, silk, wool, worsted, flax, and other fibrous substances.*"—June 12.

ALEXANDER HORATIO SIMPSON, of New Palace-yard, Westminster, gentleman, PETER HUNTER IRVIN, and THOMAS EUGENE IRVIN, both of Charles-street, Hatton-garden, philosophical instrument makers, for "*an improved mode of producing light, and of manufacturing apparatus for the diffusion of light.*"—June 17.

THOMAS WALKER, of North Shields, engineer, for "*improvements in steam engines.*"—June 18.

WILLIAM PETRIE, of Croydon, gentleman, for "*improvements in obtaining mechanical power, which are also applicable for obtaining rapid motion.*"—June 19.

JOHN HAUGHTON, of Liverpool, clerk, master of arts, for "*improvements in the method of affixing certain labels.*"—June 19.

JAMES HENRY SHAW, of Charlotte-street, Blackfriars, jeweller, for "*improvements in setting wheat and other seeds.*"—June 19.

SIR SAMUEL BROWN, knight, of Netherbyers-house, Ayton, Berwick, for "*improvements in the means of drawing or moving carriages and other machines along inclined planes, railways, and other roads, and for drawing or propelling vessels in canals, rivers, and other navigable waters.*"—June 19.

JOHN GEORGE TRUSCOTT CAMPBELL, of Lambeth-hill, Upper Thames-street, grocer, for "*improvements in propelling vessels.*"—June 19.

JOSEPH GAUCI, of North-crescent, Bedford-square, artist, and ALEXANDER BAIN, of Wigmore-street, Cavendish-square, mechanist, for "*improvements in inkstands and inkholders.*"—June 21.

MILES BERRY, of Chancery-lane, patent agent, for "*a new or improved engine, machine, or apparatus for producing or obtaining motive power by means of gases or vapours produced by combustion.*"—June 23.

WILLIAM WALKER, the elder, of Standish-street, Liverpool, watch-finisher, for "*an improvement or improvements in the manufacture of the detached lever watch.*"—June 23.

GEORGE THOMAS DAY, of Upper Belgrave-place, Pimlico, gentleman, for "*an improved apparatus for creating draft applicable to chimneys and other purposes.*"—June 23.

JOHN HENRY LE KEUX, of Southampton-street, Pentonville, for "*an improvement in line engraving, and in producing impressions therefrom.*"—June 23; two months.

JOHN GOODWIN, of Cumberland-street, Hackney-road, piano-forte maker, for "*an improved construction of piano-fortes of certain descriptions.*"—June 23; two months.

JAMES SIDEBOTTOM, of Waterside, Derby, manufacturer, for "*certain improvements in machinery for apparatus.*"—June 23.

WILLIAM CHESTERMAN, of Burford, Oxford, gentleman, for "*improvements in filtering liquids.*"—June 23.

ROBERT STEPHENSON, of Great George-street, Westminster, civil engineer, for "*certain improvements in the arrangement and combination of the parts of steam engines of the sort commonly called locomotive engines.*"—June 23.

JOHN LEE STEVENS, of King Edward-street, Southwark, general agent, and JOHN KING, of College Hill, printer, for "*certain improvements in candlesticks and other candle holders.*"—June 25.

TO CORRESPONDENTS.

Mr. Mushet's papers; and Mr. Davies and Mr. Ryder's reply to Mr. Perkins' answer, that appeared in last month's Journal, were not received until the latter part of the month, they will appear in the next Journal.

M. Q.'s communication will appear next month—tracings will be returned when required.

"The Mammoth" is to be worked by the Screw, unless new orders have been lately given to the contrary.

We must beg of our American correspondents not to forward Pamphlets by Post, we have had several demands upon us for 5s. and 6s. postage for each.

A lengthened abstract of Mr. Hood's excellent paper "on the Properties and Chemical Constitution of Coal," has already been given in the Journal, and the paper besides has appeared in another periodical.

Works received and will be noticed next month—Mr. Ranken's Patent Wood Pavement, Report on "the Improvement of the Navigation of the Forth betwixt Stirling and Alloa," "Irish Railways." Mr. Sopwith's description of Geological Models, and Mr. Williams's work on the Combustion of Coal, 2nd edition.

Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

ERRATA.

In Mr. Clark's communication "*On the Action of Central Forces,*" in the last month's Journal, page 182, 2nd column, 31st line from bottom, for $A_B^C - A B$, read $A C = A B$. And page 183, column one, line 29, for $x = \frac{r^2}{r}$ read, $x = \frac{v^2}{r}$.

the lateral cut is shorter here than the others, it is about 14 or 15 chains or 350 yards, the lift is 7 ft. 6 in. the dimensions are the same as the others, the length of the weir is 350 feet, the height from the bed of the river is about 11 ft. 6 in., the width of the river is from 100 to 130 feet. This takes us up to Red Stone Rock, and Cloth House, and to Stourport; the weir is to be in the cut there and the lock in the river, because the towing path is on the eastern side of the river, and we should have to pass over if we put a lock in the cut: I can't give the height of this weir. We dredge between Gloucester and Upton, because the shoals fall so much less in this district and are of a different character; they are shoals of deposit formed by the inequality of the sectional area of the channel. The shoals above Upton are hard beds of gravel and marl, which pen the water over in the summer season. The effect of dredging from Upton to Worcester would be to increase the liability of the banks to tumble in, and would also be inconvenient to the trader from the increased height of the banks, which are already too high: the same effect would be produced in a greater degree by dredging Upton shoal, unless there was something above. Compared with the present plan, dredging would be much more expensive, supposing it formed part of a continuous plan up to Stourport. If you removed the lock from Upton and put it at Diglis, you must have a double lift there, which would be inconvenient to the trade, as in point of fact it would be two locks. The extent of dredging in such a case must be to the extent of from 7 to 10 feet, which would be a serious matter, and would make cataracts from the locks. By the system of weirs we shall have 6 feet of water at all times from Stourport to Gloucester, which I believe would be sufficient for all purposes of trade on the Severn; I do not think it would be more than necessary for the canal boats. The build of vessels would alter if the water were deeper. In my opinion the trade of the river will be increased if these improvements are carried into effect. In my opinion if the maximum toll is imposed, these advantages will counterbalance it to the trade; I found that opinion upon the excessive delays, cost of lightering, pilferage, wear and tear, the increased power required to draw vessels up, the limited number of voyages and the light cargoes, which exist at present. The trade of Gloucester has suffered much in consequence, and has gone to other ports; to my knowledge many cargoes which, but for this, would have gone to Gloucester, have gone to Liverpool; this has been especially the case lately. I believe also that railways have increased the prejudice to the Severn. The cost of these improvements I estimate at £150,000, which will be sufficient, and more than suffice, and include contingencies, which I have estimated at 10 per cent. I am prepared to state in detail how it will be expended.

Cross-examined by Mr. Austin.

The original plan was made by Mr. Rhodes. I have been acting under Mr. Cubitt since Nov. 1825. I consider the merit or demerit of the present plan belongs to him. Mr. Cubitt was employed as consulting engineer, and Mr. Rhodes as acting engineer. I was employed by the committee of the late Severn Navigation Company. This is not the same plan as theirs, but the same with some alterations. Their plan was first made in 1838. There was a plan and sections. The original plan is at the Guildhall at Worcester. I have a reduced copy of it as altered. I took part in the formation of the original plan. It was adopted and altered by Mr. Cubitt. I said the deposit of shoals would depend on the drifts of the river. The river is divided in the plan into districts. The area of the first is at Upton, 3480 feet. That supposes a line drawn at the top of the bank and the bed of the river. The width is 104 feet, the average depth 11 feet. The next district is half a mile lower down, and has the same area; width 101 feet, average depth 10 ft. 6 in. The third is, area 3126 ft. width 98 ft. depth 11 ft. The fourth is, area 3401 ft. width 104 ft. depth 10 ft. 9 in. The fifth is, area 3529 ft. width 107 ft. depth 12 ft. The first section is half a mile below the Barley House, the second a mile ditto, the third a mile and half ditto, the fourth two miles ditto, and the fifth two miles and half ditto. That gives an average of 100 feet width and 10 feet depth, which is plenty of water for the necessities of the trade. There are no shoals there. When the water rises it expands also. The fall from Upton to Gloucester is about 7 inches, or 2·8 inches per mile. We propose to alter the whole river from Upton to Gloucester, to assimilate it at this part, and to maintain an uniform depth of 6 feet. The width of the river varies from 150 feet to 170 feet. I am not now prepared to give the Committee the detail of the cost of the works. Mr. Provis made the original calculation of the expense. The average dredging of the whole line will be less than 5 feet. The general estimate of the present plan was made by Mr. Cubitt at Worcester, in the autumn of last year. We had not a detailed estimate until within the last two months. I do not know that it is determined to lay down a quantity of rubble stone to be used between Upton and Gloucester. The depth of the water at the Upton weir immediately above is 7 feet, and below, 3 ft. 7 in. We propose to use the stuff dredged up in equalizing the width. Mr. Provis took the price of the stone from me. It was from 3*s.* to 3*s.* 6*d.* per yard, delivered not at the spot, but on the Severn. Part of it comes from between Worcester and Stourport, and the other part from Malvern. I can't tell the cost of the stone and timber between Worcester and Upton. We propose to coffer-dam at Bevere Island. The soundings for the shoals were under my direction. The borings were in many instances from 8 feet to 10 feet. Maisemore shoal was not bored, it being out of the direct line. We bored all the other shoals. We took 26 borings in the Worcester shoal.

By Mr. Serjeant Wrangham.—I do not know the quantity of work to be done for the purpose of improving the navigation. It will be a work of considerable amount to get a depth of five feet at Deerhurst shoal with a width of from forty to sixty feet. The dredge below Upton Lock will be on an average of from 4 to 5 feet for the same width for the length of a mile. I believe these excavations will not depress the level of water because they are shoals of deposit and not natural formations, and there is no fall from them. By dredging to Worcester you would be making the river a succession of rapids; if we deepened to a sufficient extent in low summer water we should get rid of the rapids, but we should lower the ponds above; it would do so even with the same sectional area. By narrowing the banks and increasing the depth the stream would flow faster: the shoals do not pen the water back except where it acts as a natural dam. From Diglis lock to Upton weir the total depth is 4 ft. 6 in.; this space contains a great number of rapids; the fall is 1½ inches per mile, with a soft bottom, but with a shoal of hard gravel and marl. I think that dredging up to Upton would not retain the level; there would be a diminution at Diglis lock of 3 ft. 9 in. by dredging, if the water was not penned back by our lock; that would leave a fall of 9 inches from Diglis lock to Upton. The river is not so broad from Diglis to Upton as below Upton; and being so, the fall above is greater than the fall below, but it must not be naturally so; it depends upon the inclination of the bed of the river, and the quantity of water carried. Many rivers, particularly the Thames and the Kennett, have had their navigation improved by artificial means. The current of the Thames is much faster than in the Severn. The velocity of the flood of the Severn is from 2½ to 3 miles per hour. Mr. Provis can give you a more satisfactory answer than I, as to the force with which that would strike our weirs. I have seen a portion of the surface of the weirs in the Thames washed off by the water. They are made in a very simple way—by piles, filled up. Our weirs will be much stronger than the Thames. During the six years I have been engaged on the Severn my attention has been particularly directed to these subjects, and the information I have given to the committee is the result of that investigation. Mr. Provis was called in about two months since. I have made a calculation of the time at which the river may become free again; and taking all things into consideration, I think it may become a free river again in forty years, with the exception simply of a toll for keeping the works in repair. My estimate applies itself to the cost of tonnage. I am sure I furnished Mr. Cubitt and Mr. Provis with sufficient information to give an opinion on the subject. The time now lost in consequence of the shoals is much greater than will be lost in going through the locks. The impediments to the navigation of the river now are much greater than can possibly exist under the improvements. I have passed vessels through the locks on the Thames in 3½ minutes; about 5 minutes is a fair average. Supposing a boat to start to Gloucester in a fresh, which, before the alteration, could get back in the same fresh, it would have greater facility for doing so in consequence of the improvement of the river, notwithstanding the locks.

Mr. Provis, Engineer, examined by Mr. Serjeant Merewether:—I have executed works for Mr. Cubitt, and other engineers. The Menai Bridge was one of those works. The Birmingham Junction Canal was another, and I am now employed on works to the amount of £60,000 or £70,000. I was called in to give an estimate for the proposed works on the Severn, and Mr. Williams and I went down the river from Gloucester to Stourport, and I made my own observations in addition to the information given me by Mr. Williams. I have an estimate of the whole cost of the works, including 10 per cent. upon the cost of the works for contingencies, but exclusive of the land to be taken, which I do not pretend to value. The amount of that estimate is £133,108 12*s.* 3*d.*, being £121,007 16*s.* 7*d.* for the total cost of the works, and £12,100 15*s.* 7*d.* for contingencies. I have made such a calculation that, if the work were offered to me, I should have no objection to undertake it at that contract, providing the supervision was such as I liked. Were I employed as an engineer to examine that estimate, I should say that it is a fair sum to give to any man to do the required work. The cutting required at Upton will cost £1656 17*s.* 6*d.*; the lock at Upton (including the building, the gates, and every thing necessary to complete it,) £6321 4*s.* 2*d.*; the weir at Upton, (including all that is necessary, rubble stone, &c.) £3887. [It was here understood that the odd shillings and pence should be left out to simplify the statement.] This would make the total expense at Upton £14,865. Worcester, cutting £1210, lock £6231, weir £2848; total £13,379. Bevere: cutting £1082, lock and coffer dam (which I think will be required there) £10,768, weir £1569; total £13,421. Holt Fleet: cutting £3347, lock £5863, weir £1658; total £10,869. Lincombe Hill: cutting £5126, locks and dams (not coffer-dams but embankments) £8072, weir £2016; total £15,214. Total of the five totals £67,750. The five lock-houses will cost £1250. This includes all the work except the equalisation and works below Upton. The total dredging will cost £18,141. Protecting the sides of the river, £33,866. These two items make £52,007. The three totals make £121,000. With the best judgment I can form, I think this is sufficient for the work. I have made estimates to the amount of millions.

Cross-examined by Mr. Austin.—The quantity to be dredged between Upton and Gloucester, including both branches of the river, is 311,000 yards, which I estimate at 1*s.* per yard. I believe that to be the full price, and I include the taking away and depositing the soil, the whole of which is proposed to be used in narrowing the river. There is no intention to take any away, except, perhaps, throwing a little into some of the deep holes, and putting some of the best gravel on the towing paths, which are very bad. This work, will come to £15,500, which is a very large proportion of the total cost of dredging, leaving only £3000 more to be expended on dredging between Upton and Stourport. It is proposed to face the channel with rubble stone, at an inclination of 3 to 1, extending from the bottom of the dredged channel to the height marked in the section to represent the spring-tide level. There will be 193,520 square yards of rubble stone facing between Upton and Gloucester, or about 132,000 cubic yards, at 3*s.* 6*d.* per square yard, or 5*s.* 3*d.* per cubic yard. The stone can be procured at the Red Stone Rock, at Lincombe Hill, and at Holt Fleet. The mode in which the facing is to be done, is first to set the dredging machine at work, and then to throw the stone promiscuously into the channel, marks being set up for the guidance of the men who discharge the cargoes of stone. The rubble stone facing was my suggestion, and Mr. Cubitt has adopted it. I cannot tell how much sand or how much gravel will have to be dredged above Upton, as the quantity of dredging is so very small that I did not consider it worth while to examine very minutely. It would be a little harder to dredge stones than gravel, but not much, because if the stones were large we should remove the buckets from the machine and replace them with claws, which would take up detached stones. I estimate the excavation at 10*d.* per yard, which includes the removal of the soil, placing it behind the stone walls, and sloping it from the top. We shall be driven to the plan of dropping in the stones for the weir till they rise to the surface, when they will be placed by hand, except where we make a cut, and then all the stones will be laid by hand. At the foot of the weirs it is proposed to have rubble stone, sloping at an angle of 3 to 1. We propose to make our weirs water-tight by having the sheet-piling jointed and grooved, and, as it will be driven comparatively dry, the swelling of the wood when it comes in contact with the water will be quite enough to make every joint water-tight. We do not resort to puddling. I have not made any estimate of the cost of the land which will be taken, nor for any compensation in case the drainage is affected. I have only estimated the cost of facing one side of the river at any place. This estimate has been in progress two months. I have not made any alteration in it from the first, saving to correct some little mistake respecting the quantities.

Re-examined by Serjeant Merewether.—The reason why I use stone instead of dwarf piling is because it is more durable than timber, and more proper to be used; but if it became a question, and it was deemed desirable to use timber in any particular part, then I should adopt timber. There are localities near the river where we can get stone very easily. The price I have stated is quite sufficient to cover any difference in the nature of the soil to be dredged. In constructing a weir we first put in piling. I have no reason to apprehend that the stone will be carried away, because there will be a great mass of it, placed at a considerable slope; I think the weirs will be quite strong enough to resist all pressure. I have not made any of these weirs myself, but I have taken drawings of some which have well answered the purpose for which they were designed. The walls are of the same description as those adopted by me in the river Dee, which is a rapid river. My cross-examination does not shake my conviction in the least, as to the strength of the wall.

Mr. Cubitt examined by Mr. Serjeant Merewether. The following are the principal items of his evidence:—Our plan will not affect the drainage below Upton at all, and will be the best with reference to expense. The dredging at Maisemore will be so small that the effect of it upon the Gloucester channel will be inappreciable. We shall dredge in the deep water channel. The plan proposed above Worcester has been adopted because in that district our object can be better and cheaper attained by it and with less injury to the surrounding lands. As an explanation of this, six inches of water going over a weir 600 feet long would take all the summer water in the Severn; 25 inches over a weir so constructed would make a good navigation and effect a good drainage of the land, and before injury could ensue the weir would become obsolete. We seek a channel of 45 feet from Upton to Diglis, with a rise at three inches per mile. The amount of dredging here would be upwards of 300,000 cubic yards, at 1*s.* per yard, which would be £15,000, which is the price of all the works at Upton. The lift between Worcester and Upton Bridge must be the sum of two lifts. If the two falls be brought to Worcester there must be two locks at the double fall, which would be more expense, in addition to the cost of £15,000 for dredging. I therefore think this is a sufficient reason why the weirs and locks should begin at Worcester. I apprehend there will be no difficulty whatever in the works answering their purpose when made. In putting the weirs across the river quite square it becomes a dead stop in proportion to the height and width of the weir to a portion of the section of the river, and backs up the water; but the quantity of water that falls over the weir is never of a longer sheet than the breadth of the weir, so that were the banks full there must be an obstruction. An oblique weir is the simplest, cheapest, and most efficient to dam up the river without injury. [To elucidate this, Mr. Cubitt produced a model of the proposed works and explained them in detail to the Committee, and also the scientific principles on which they were adopted.] I have considered the point of the sluices in the weir. I think them inexpedient. The flood gates would have no perceptible effect in such a case; and flood gates, as such, in the weirs would cost more than the weirs themselves. The weir is quite as capable of penning off the water without flood gates as with them.—If any works are put to improve Lord Sandys' drain it would not impede the navigation. My object has been to raise all the works, towing paths, &c., above the floods.—I do not intend to dredge away the quantity Mr. Provis stated at Maisemore shoal, or to do more to it than will be necessary to let the Maisemore boat pass. There is more in the Parliamentary sections than is necessary to be done, and so far there is a greater degree of safety.—I was first employed to make observations on this river by Mr. Lea, the Chairman of the Association at Worcester. I made my report to Lord Hatherton, the Chairman of the Committee of the Severn Association. I had met Mr. Williams professionally before. I was engaged with Mr. Rhodes in the plan of 1836; that was a plan involving the erection of weirs above and below Gloucester; the weir below Gloucester would have been in a portion of the river now avoided by the Gloucester and Berkeley Canal. The plans of the present day are the same amended; I approved of them in general, but not in all things. I have no doubt that we might get six feet of water by dredging up to Worcester, but it would be much more expensive. It is proposed to place a wall where we dredge. I have estimated for eight miles of walling and dredging; that will answer the double purpose of narrowing the river and securing the banks.

Mr. Cubitt cross-examined by Mr. Wortley.—Mr. Williams correctly described the mode of laying down the rubble stone. At one time I proposed to use dwarf piling in some places; and I still intend to do so, where I think it will be as cheap and efficient. In some respects it is preferable to stone, in others it is not so. I can't mention any part of the river in which I think it will be preferable. I do not propose to make the slopes of the banks perfect in all places, as Mr. Provis did, because I think there will not be stuff enough to do it. The channel of the Deerhurst shoal is rather straight; the deepest water is towards the left bank going down. It is not absolutely necessary to stone up to the high-water mark. The length of the dredging on the river between Upton and Gloucester upon my scheme, as marked on the sections, is between eight and nine miles. I should remark, that it is marked deeper than will be necessary for the navigation. I do not contemplate any works below the Gloucester and Berkeley Canal, nor below the entrance to the Gloucester and Hereford Canal. The continuous length of dredging in the sections, from Upton to Diglis is nine miles. We propose to start from Upton at a depth of 7 ft. 6 in.; and we do so because I don't think 6 feet sufficient. By the 6 feet spoken of as the depth we seek, I mean 6 feet above the lock sills. I save all the dredging there by penning the banks. Were we to dredge from Gloucester to Worcester to a width of 45 feet at the bottom, to the level of the lock sill of the Gloucester and Berkeley Canal, 5 feet in depth, with a slope of two to one, and rising 3 inches per mile, the quantity to be dredged would be 323,133 cubic yards. (Witness then answered a series of questions as to the volume of water that would flow in channels of different widths.) We shall scarcely affect the fall below Upton. We propose at Upton to form a close jointed waterproof weir, slanting, 600 feet long, with timber pilings driven into the river, 10 feet apart; behind this we propose to drop stones into the river, without masonry. The expense of having the lock at Diglis, instead of Upton, would be very much increased on account of the additional fall. In some places where we construct our weirs we widen the river, in which cases the cross sections would be as great or greater than at present. I measured that section across the river at right angles to the stream. The height of the water above the weir is 6 inches. I know by principle, and partly by practice, that when the water is 2 feet above the weir the boats will go over. The water, in coming to the weir, does not diminish its velocity, and no more water would pass over the weir in consequence of its being oblique than if it were right angled. I do not make a pond, and therefore I do not cause a deposit. If you do any thing to diminish the velocity of the water coming through the weir it will tend to form a deposit; but if it be so constructed that the water coming through can keep moving on with the same velocity, it will have no more tendency to form a deposit than before the weir was put in. If I were to carry out the works at once I do not intend to make any alteration in the length of the weir; and if I did so at all, it would be to meet the views of others rather than my own convictions. If the river be increased beyond its natural width it will be more liable to deposits. The expenses of general maintenance of the works can never cease while the works exist. The expense of the navigation of the Ayr and Caldwell is very considerable. We do not alter the natural surface of the water at Diglis locks to any extent; if the weir were placed above the entrance to the canal, vessels would have the same depth of water. The reason I have for not placing it higher up the stream is that it would lengthen the cut very much, take more land, and much reduce the water to what I may call the harbour of Worcester. The length to the harbour is 1000 yards; it would increase the length of the cut about nine chains. There would be great passing of vessels from all places at the point, and therefore I think there should be a good harbour. If the vessels coming at the same time had to wait for the lockage, it would be the best place to wait in, but there would be little or no waiting, as they would pass the lock in three or four minutes. At Bevere Island I propose to put the weir below the mouth of the Salwarp; Mr. Rhodes in his last plan has placed it in the same place. By putting a weir in a shallow stream we raise the water; but the instant it gets so much above the weir as to lose a fall, from that instant the weir is no obstruction. I have had but little experience in salmon rivers; I understand there are good salmon in the Severn, and I should be very sorry to do anything to destroy them; I have nothing to do with how far these works will affect the rights of piscary; I have considered how to form the weirs so as not to obstruct the salmon in passing up the river; the weirs will not afford any facility for taking the fish. The average yield of the river at low summer water is from 40 to 60,000 cubic feet per minute above the Avon; the quantity of course differs below the Avon.

By Mr. Lowndes.—I have not personally taken the levels of the drains on the river Severn; I received information from Mr. Williams, and a great deal from Mr. Rhodes; I don't know that Mr. Rhodes personally took the levels. I received the greatest information on this point from the documents. I examined the drain on Lord Sandys' property myself; if you proved there was an under-drain there it would not matter on atom. I consider the sole operation of a drain to be to take the water off the surface of the land; the effect of an under-drain is to take off that which gets below the surface of the land. If there is an under-ground drain it does not follow that the level must be the same as that of the open drain. I do not know whether there is an under-ground drain at this place, but I believe all the drains on Lord Sandys' property come into the Severn below the weir.—When a fresh comes down the river the surface of the river will remain nearly the same as before the weir was put in. The works will raise the water on the river at Salwarp perhaps four feet. The value of the land to be taken will be proved hereafter by other witnesses. If it should be proved that 2000 acres for instance would be injured in their drainage by the bill, there has been no estimate made of the amount of compensation for that. I can't give any opinion as to the permanency of any damage that might ensue. I admit that the consequences of imperfect drainage would be to effect the atmosphere of the district. The state of the towing paths is not good; they give way on both sides of the river. When they have given way, it is generally the case that the land is encroached upon for a fresh one, which they are entitled to do. If they are entitled by their Act to take 10 feet on the side of the river, and that falls in, I am of opinion they can take 10 feet more; notwithstanding this, I do not think it is imprudent in us to undertake their management.

Mr. Mc'Neil examined by Mr. Serjeant Merewether.—I am a civil engineer, and have been engaged in many extensive works for a period of 20 years. I have been present during the last few days of this enquiry. I have been engaged in works of a similar description to the present. Having heard the plan, I think it would effect the desired object. I think it would be best to dredge up to Upton. I think, also, that the weirs will effect Mr. Cubitt's object. With reference to expense, I think it is the best mode that could be adopted. I think the explanation given by Mr. Cubitt has been so clear, that nothing remains to be added to it.

Cross-examined by Mr. Austin.—I was called in on this business on Monday week. I had not made a previous examination of the river Severn. I never did so. I have been across it at Chepstow, but never practically examined it. I do not know any other river of a similar natural character. I under what circumstances, so awful a catastrophe would have occurred, of course not even those best acquainted with the subject could pretend to describe. Mr. Cottingham has caused about 150 wagon-loads of rubbish to be removed from the tower in order fully to ascertain its state, and there can be no doubt that the measures he intends to adopt will give full security. One great advantage, too, of his plans will be to expose the 52 stone columns of the tower (a remarkably fine piece of masonry) to the view of persons in the church. In the mean time, so imminent does he consider the danger, that he will not suffer the bells to be rung, and all attention to the other parts of the works is suspended until satisfactory reparation has been made. The restoration will now be effected at a comparatively trifling expense; had the discovery not thus timely taken place, the cost would have been enormous. It is worthy of remark that so little were these subjects understood only a comparatively short period ago, that the western front was declared to be secured for hundreds of years, and yet in six weeks only from the time of that declaration it was a mass of ruins.—*Hereford Journal.*

LIVERPOOL DOCKS.

It will be recollected that in the last February number of the Journal, we gave a letter of Mr. Hartley's, the Dock Surveyor, addressed to the Liverpool Dock Committee, in consequence of certain charges being brought against him by a Member of the Committee, whereupon a Sub-Committee was appointed to inquire into the charges. This Committee have lately made their report which is now before us, we are happy to announce, what we feel assured the whole of the profession were prepared for, that it completely vindicates Mr. Hartley from the charges. The report is too long for insertion in our Journal, but the following announcement we are sure will be all that is necessary for us to give.

"The sub-committee, having personally examined the accounts at the Dockyard, and the system of checks on labour and expenditure of stores, are unanimously of opinion, after a very strict investigation of the stock accounts, and careful examination of the books, which show in detail the expenses incurred in every department of work, and making allowance for the expense of the establishment and maintenance of a large stock, that the various works have been executed on very reasonable terms, and at lower rates than they could have been in any other way. The interests of the Dock Trust, in the conduct and management of the mechanical departments of the Surveyor's establishment, have been materially promoted by the system which has been pursued; and, as long as that system is kept up in the same orderly, vigorous, and efficient manner, no better system can be devised for the general benefit of the trust, the establishment being highly creditable to the Dock Surveyor, *whose indefatigable zeal, honour, and industry cannot be too highly commended.*"

Removal of Sunderland Light House.—At a late meeting of the Commissioners of the river Wear, the taking down of the Light House being discussed, as part of the plan of building the new North pier at the mouth of the harbour, Mr. Murray, the engineer, suggested the removal of the Light House, in its present entire state, to the eastern extremity of the new Pier, a distance of about 420 feet, so as to make it serve the double purpose of a stationary and a tide-light. Mr. Murray exhibited a model of the building, and after explaining how he proposed to effect this undertaking, the Board decided that he should proceed forthwith to remove it. This Light House was erected about 40 years ago, by the late Mr. Pickernell, then engineer to the Harbour Commissioners. It is wholly composed of stone; its form is octagonal, 15 feet in breadth across its base, 62 feet in height from the surface of the pier to the top of the cornice, where it is 9 feet in breadth across, and the top of the dome is 16 feet above the cornice, making a total height of 78 feet; and its calculated weight is 250 tons. Mr. Murray intends to cut through the masonry near its foundation, and insert whole timbers, one after another, through the building, and extending 7 feet beyond it. Above and at right angles to them, another tier of timbers is to be inserted in like manner, so as to make the cradle or base a square of 29 feet; and this cradle is to be supported upon bearers, with about 250 wheels of 6 inches diameter, intended to traverse on 6 lines of railway to be laid on the new Pier for that purpose. The shaft of the Light House is to be tied together with bands, and its eight sides are to be supported with timber braces from the cradle upwards to the cornice. The cradle is to be drawn and pushed forward by powerful screws, along the railway above mentioned, on the principle of Morton's patent slip for the repairing of vessels. However surprising the removal of such a building may appear to many, yet in New York, for some years past, large houses have been removed from their original situation to a considerable distance, without sustaining any injury. The immense block of granite, serving as the pedestal of the equestrian statue of Peter the Great, at St. Petersburgh, was conveyed four miles by land, and thirteen by water. Several Obelisks have likewise been transported at different times from Egypt to Europe; and lately, one was conveyed from Thebes, and erected by the French at Paris. But the fact that the Light House on our North Pier is composed of stones of comparatively small dimension, its great height, and small base, make the operation of removing it much more difficult than any thing of the sort ever attempted. We heartily wish the enterprising engineer every success in his bold and novel undertaking, which is to be carried into execution in the course of a few weeks from this date.—*Sunderland Herald.*

COMPETITION FOR THE MARSEILLES EXCHANGE.

The following conditions of competition for designing an Exchange at Marseilles, we have translated from *Revue Générale de L'Architecture.*

1st. The situation will be chosen in a *perimètre* commencing at the "Rue de la Prison," and proceeding up to the "Place de Justice," the Grand Rue as far as the Courts.

2nd. The competition designs must contain, not only the Exchange strictly so called, but also the Chamber and Tribunal of Commerce, the syndicat of the money-changers, the royal brokers, the merchant counsel, and all the necessary appendages to these, such as peristyle porticos, vestibules, vestries secretary's office, registry office, bureaux, counting houses, &c. &c. Also a dwelling place for the porter, a guard-house for a detachment, and a place to deposit cloaks, umbrellas, and walking sticks.

3rd. The great hall of the Exchange, including the interior porticos must contain at least 3000 persons, and consequently have a superficies of not less than 1000 square metres.

4th. The drawings must be done with care, the sections to be in a pale colour, the horizontal sections in Indian ink, and carmine for the vertical sections, yellow for the wood, Pussian blue for the iron, grey for the metallic roofs, and brick red for the tile roofs.

5th. Each design must be composed of the following separate pieces.

1. An explanatory and justifiable report.
2. A general plan of the whole.
3. A plan of the ground floors at one or two metres above the level of the great hall, and the same of the first floor.
4. Longitudinal and a transverse section through the interior of the edifice.
5. Front and back elevations.
6. Profiles and details of execution (this need not be paid so much attention to).
7. A descriptive device containing a scale of the works, and the cost after the current price of the country; the whole exactly and summarily expressed.

6th. As to the order of architecture, the best in whatever order it may happen to be chosen, and even the several orders may be blended, but keeping at the same time a tone of convenience, solidity, elegance, good taste, a noble simplicity, and a wise economy.

7th. The scale of the general plan to be, 2 millimetres to a metre, that of the sections and separate plans a centimetre to a metre, and that of the details of execution 5 centimetres to a metre.

8th. The competition is fixed at six months date from the 1st April. During the following fortnight the competitors to deposit their designs at the secretary's office, at the Chamber of Commerce, where they will receive a certain number according to the order of presentation, the names and address of the competitors must be enclosed in an envelope carefully closed, to which the same number will be affixed. Each competitor to have a receipt stating the formal deposition, the number of plans, and the particular number given them, but without indicating name or person.

9th. When the term for the preparation of the plans has expired, the designs will be submitted to the judgment of a committee chosen from the members of the Chamber of Commerce, and an equal number of artists. The decision will not be definitive until the sanction of competent authorities be given, and then the names only of the authors of the three best designs will be announced.

10th. The first design will receive the prize of 3000 francs (120*l.*), and then, without further remuneration or honours, will remain the property of the Chamber, who will have the right to alter it at their will, and to confide the execution to whom they please. The names of the other two authors of the second and third best designs will be honourably mentioned.

11th. Every design (No. 1 excepted), will be restored to their authors, as well as the sealed envelopes containing their names, on the production of the previously delivered receipts.

Marseilles, March 30, 1841.

CANAL STEAMER FITTED WITH MR. P. TAYLOR'S REVOLVING SCREW PROPELLERS.

On Wednesday the 5th of May, we had the pleasure of inspecting a new steam boat on the river Irwell, fitted by Messrs. Peter Taylor and Co., of Hollinwood, near Manchester, with steam engines and propellers of an entirely new construction, both inventions of Mr. Peter Taylor, and for which he has obtained patents. The vessel is 75 feet long and 10 feet wide, and built (with the exception of the gunwale and paddle-box,) entirely of iron. She appeared to perform very satisfactorily; at a speed varying according to the depth of water from about eight to nine miles per hour, which upon a confined water we believe has never been attained by any steam vessel. In noticing a trial some months ago of another vessel belonging to Messrs. Taylor and Co., which had then been newly fitted with similar propellers, we gave a description of the apparatus, which consists of a number of continuous curved vanes or segments of screws, or wings on two axes. In the instance now under notice five pairs are affixed upon one axis, and five pairs upon the other; the number being regulated by, and varied according to, the power of the steam engines and the extent of surface of the vanes or blades, which have the appearance of small windmill sails, and have been very appropriately named *revolving screw scullers*: each set consisting of five pairs are six feet in diameter. The vanes of one set work betwixt the vanes of the other in the same manner as the teeth of cog wheels; by this arrangement the two sets, although six feet in diameter, are together contained in a paddle-box (there being only one): it is 9 ft. 8 in. in width, and placed at the stern of the vessel; the smallness of the space occupied offering great convenience for passing locks.—The scullers are well protected from the banks or sides and bottom of the canal, with which it is almost impossible they can ever come in contact. The paddle-box occupies seven feet in length, and has the effect of extending the boat so much. The width or breadth is regulated by the width or breadth of the boat, which in the present instance is 10 feet outside. The two shafts or axes are placed at an equal distance from each other, as well as at equal distance from the sides of the boat or box containing them, and with which they run parallel; and as we have before observed, the shafts or axes are so arranged in respect to each other, that the vanes or oblique surfaces of the one can enter between the vanes of the other shaft or axis; thus obtaining a great extent of propelling surface within a very confined space. The axes are placed considerably above the water line, and the curved oblique vanes or scullers are affixed upon the shafts or axes in opposite directions, that is, they are affixed upon one shaft or axis in such a manner that they may be said to form parts of a right-handed screw, and upon the other shaft or axis, so that they may be said to form parts of a left-handed screw. This novel propelling apparatus is worked by a pair of *semi-rotatory steam engines*, also Mr. Taylor's invention. The steam boiler is of the same description as those used upon the railways. It is placed towards the stem of the vessel, and the steam engines close up to it. To one axis of the propelling apparatus is coupled a shaft, which runs lengthwise to the steam engines. The starting, reversing, and stopping apparatus is connected with the regulator of the steam engine, and affixed at the stern of the boat, within reach of the steerer, who manages the whole when necessary. This is a most simple and beautiful arrangement, the helmsman being altogether independent of the engineer. He can start, stop, or reverse the engines at his pleasure. The helm or rudder is placed in the usual position, and is immediately behind the propellers.

The vessel has been engaged during the last month on the Bridgewater Canal towing boats; at one time she towed six boats, their united cargo being equal to nearly 600 tons, at the rate of three miles per hour, and at another time she towed four fly boats equal to 60 tons, a distance of six miles in one hour 16 minutes.—*Manchester Times.*

BENEVOLENT INSTITUTIONS OF THE ENGINEERS.

Since the notice which we gave in our last, the promoters of the plans for giving relief to the members of the profession and workmen employed by them, have succeeded in organizing an institution for each of their respective objects. That for the relief of distressed engineers has received the countenance of the Institute of Civil Engineers, and the Society for the workmen goes on, receiving increased support from the mechanical engineers, who we trust will give every support to an object so well deserving; a subscription list is now open, it has been, we are happy to say, liberally signed by the masters.

KING'S COLLEGE.

We are glad to learn that the department in King's College hitherto devoted to engineering, and to the mechanical and manufacturing arts is about to be extended, so as to embrace also the principles and practice of architecture. The existing provision in King's College for the education of the engineer having also drawn thither students in architecture in search of instruction adapted to their pursuits, the desirableness of the proposed extension became evident. King's College is then likely to be the first collegiate establishment to undertake the preliminary education of the architect as such, as well as in literature and science generally, and we cannot doubt of its success in so doing, nor of the good that will be thereby effected both to the profession and to the public.

Monument in Westphalia.—A remarkable monumental structure is at present raising, or about to be raised, in that part of Westphalia where Arminius overthrew the Roman legions, commanded by Varus, to commemorate that event. The monument is to consist of a statue of the German hero, similar to the many images which may still be seen under the name of "Ermin Sæulen," in various parts of Germany, and which became, in the early periods of the Christian era, objects of idolatrous worship. The statue is to be of copper, 42 feet high, and to the point of the uplifted sword 75 feet! It is to be placed on a circular temple 90 feet in height, on the top of the hill Teut, in the Teutoburger forest. The monument promises to do honour to German art, and the idea of erecting such a work is a proof of the patriotic feeling of the Germans. The expenses are to be defrayed by subscription, and all the sovereigns of Germany have contributed.

SEVERN NAVIGATION IMPROVEMENT.

Abstract of the Engineering evidence for improving the River Severn, given before the Committee of the House of Commons, on the Bill, May 5, 6, 7, 10 11, & 12, 1841.

Mr. E. L. Williams, Engineer, was examined and stated that the fall in the Severn is slight compared with the Thames. The fall in the Thames from Abingdon to Henley is 2 feet per mile. The fall in the Severn in this district is about 9 inches per mile. On the Thames also there were the conflicting interests of millers and others who had private rights connected with the water which was not the case with the Severn. The operations on the Thames have been to the benefit of the navigation. The course of the Severn is comparatively straight, and its width comparatively uniform, which circumstances are favourable for our operations. I attribute the shoals of deposit to variations of width. There is little tide above Gloucester, and this will not affect us. Our first weir is below Upton. We propose there to make a lateral cut, with a lock in it with a lift of five or six feet. Between Upton and Gloucester below the lock we propose to equalize the area, or water-way of the river, by contracting it by embankments in certain parts and widening it in others. The effect of contracting it will be to preserve clear what we have dredged. We shall contract the area by decreasing the width and lining the banks with stone. I have experience of the natural way in which the water-way is preserved. The finest channel in the river is from Sandy Point to the Mythe Bridge near Tewkesbury, which preserves the water-way throughout from the quality of the sectional area. I infer that if we form the same results we shall produce the same effect. The average depth there at low summer water is from 10 to 12 feet throughout. I anticipate that the artificial banks will be principally confined to the district between the Mythe and the Haw Bridges. This space includes the Deerhurst and other shoals which we propose to dredge. I have here the sections of what we propose to do. The first shoal of importance we propose to dredge is at Gloucester, in the eastern channel alongside the Quay at Gloucester, extending from the lock of the Gloucester and Berkeley Canal to the other bridge. In fact we propose to dredge to a trifling extent from the Westgate Bridge to Sandhurst, a distance of two miles. In the western channel we propose to dredge sufficiently to allow canal boats to enter the Gloucester and Hereford Canal. We then come to Wainlode Hill; there is not much dredging to be done there. We then come to the Haw, which is laid down for dredging to a certain extent, but not requiring the shoal to be taken out. There is a section laid down for the other channel, and there is sufficient water for the purposes of navigation under one arch of Haw Bridge. We then come to Deerhurst, where the area is to be equalized and the channel dredged. At Sheplock we do the same thing: also at Lower Lode up to Cumberland, where similar operations are required. We then come to Bushley Reach and Saxon's Lode, where we dredge and equalize the area. Then we come to Upton, where we make our first lateral cut. There will be no interruption to the navigation while the cut is being made, and when the weir is being made the lock will be open. The lock will be 20 feet wide, 100 feet long, with 5 ft. 6 in. lift. We then place our weir obliquely to the current, about midway between the upper and lower entrance. The length of the weir is 600 feet. It will be constructed with sheet piling and rubble stonework. The height of the weir above the surface of the present bed of the river will be seven feet. The effect of this weir will not prejudicially affect the drainage of the surrounding district. I have surveyed the falls of the lowest drains in the district, and find the lowest will be above our permanent water line. This answer will apply to all the drains throughout our operations. I have taken the greatest pains to satisfy myself on these points. We do not raise the water there in any way; and I believe the effect of the works will be to expedite the passage of flood water and not to detain it, because we clean out the channel. Above Upton we do raise the level of the water in some places, but in all cases it will be below the drains. I have made a section of Lord Sandy's drain. I find there is a fall of 9 feet in the first 100 yards of the land drain. The drain itself is below the weir, and consequently cannot be affected by it. We then come to the shoal at Ryal Watering, and take a little off the top of it by dredging. At Hanley we do not dredge, as we shall get sufficient water from the pound to pass over. Dredging with simultaneously pounding back the water would produce a bad effect. At the Rhydd we take the top of the shoal off. At Clevelode, Pixham, and Kempsey, we do the same. These are the shoals mentioned as affected by dredging. We then come to the Ketch shoal, which is to be dredged. The Silver Ford shoal is to be dredged slightly. We then come to lock No. 2, which will be similar to the previous one, a cut with a lock in it, each of the same dimensions as the other, with a lift of 7 ft. 6 in. and a weir. The water is penned back sufficiently at Upton Bridge by the shoal: the height of the weir will be 11 ft. 6 in. from the bed of the river, the length 400 feet; it will also be placed at a sharp angle, and constructed in the same manner as the other; the piles are elm, oak, and fir. After the water has passed over the dam of sheet piling, it will fall on a dam of stone work, and we thus prevent a pool there; this will remove the obstructions immediately above. We have now passed Worcester and are come to Bevere Island, where is our third lock: the river there divides itself into two branches, which supersedes the necessity of an artificial cut, and we deal with it as such, placing a lock of the same dimensions in one branch and a weir in the other; the lift is 4 ft. 6 in., the length of the weir is 400 feet; it will be placed obliquely as the others; with some trifling dredging this is sufficient up to Holt, where we have another lock, No. 4. The length of the proposed cut is about a quarter of a mile on the Ombersley side, on Lord Sandys' property. I know of no damage that the estate can suffer by our taking that bit of ground. Our works will not be in sight of Ombersley House, which is a mile and a half to the left; the length and construction will be the same, the lift 4 ft. 6 in.; the locks will be built of brickwork; the length of the weir there will be 350 feet, the height 7 feet from the bed of the river; the obliquity is to give facility to the passing of the water, this will operate to prevent dredging except very slightly up to Lincombe Hill, where is our fifth and last cut:

Fig. 10, M is the Electric Detector, for detecting injury caused to the wires, either by contact with the pipe or with each other, fracture, or water.

m, is a small battery; 1 *m*, 2 *m*, are "feelers," in connection with the battery and detector. Whenever these feelers touch each other, an electric current passes from the battery and influences the index of the detector M, by turning it on its axis. J J are iron boxes which occur at short intervals along the line, each fitted with a screw lid, and so connected as to render them continuous with the tube C. The terminations of each length of wire rope one introduced into the box and each wire screwed with its fellow to a piece of wood fitted to the bottom of the box, so that the wire marked 1 is continuous throughout its length and always connected by the screw 1, by which it can be recognized at every box along the line. The openings by which the wires enter the box are hermetically sealed with composition; but a small tube passing through the box admits of a free communication of air from a distant reservoir. Suppose wire 1 to have become in partial contact with the tube, either by the metals touching or the presence of water: upon opening the box at which the wire is to be proved, the screw 1 must be taken out, and the feeler 1 m brought in contact with one end of the separated wires, the other feeler being kept in contact with the pipe. If this portion of the conducting wire is sound, the detector needle remains stationary; but upon removing the feeler, 1 m, to the other liberated end of wire, the detector index moves on its axis, and indicates on the graduated scale the degree of contact existing between that portion of the wire and the tube. Supposing the experiment to be tried again at the next box, and the contact proved to lie between the two boxes, the intervening faulty portion of wire is exchanged for the sound wire marked 0, (which is a spare wire introduced by such repairs) by this means the wire 1 is again restored to soundness; it is obvious that different portions of the spare wire, 0, may thus be employed to repair a damaged wire, at numerous short intervals along the line, without rendering it necessary to disturb the line generally; the minutest changes in the insulation of the wires from dampness, &c., can be detected by this valuable instrument, and corrected by blowing through the pipe a draught of dry air from the reservoir.

When a length of wire-rope has to be removed, in consequence of accidental injury, the connecting screws in the boxes at each end of the length are taken out, and one end of the wires to be removed is bound to the end of a fresh length of wire-rope conveniently wound upon a drum. The further end of the faulty length is then drawn out of the tube and wound upon an empty drum, as the new rope gradually takes its place. The screws again unite the ends of the wires, and the line is restored. The faulty length of wire, after undergoing examination and repair, is again fitted for use.

Each wire is separately covered with cotton and India-rubber solution, and the set of wires made into a rope, which is passed through a hot resinous varnish before being introduced into the tubes.

Fig. 11.

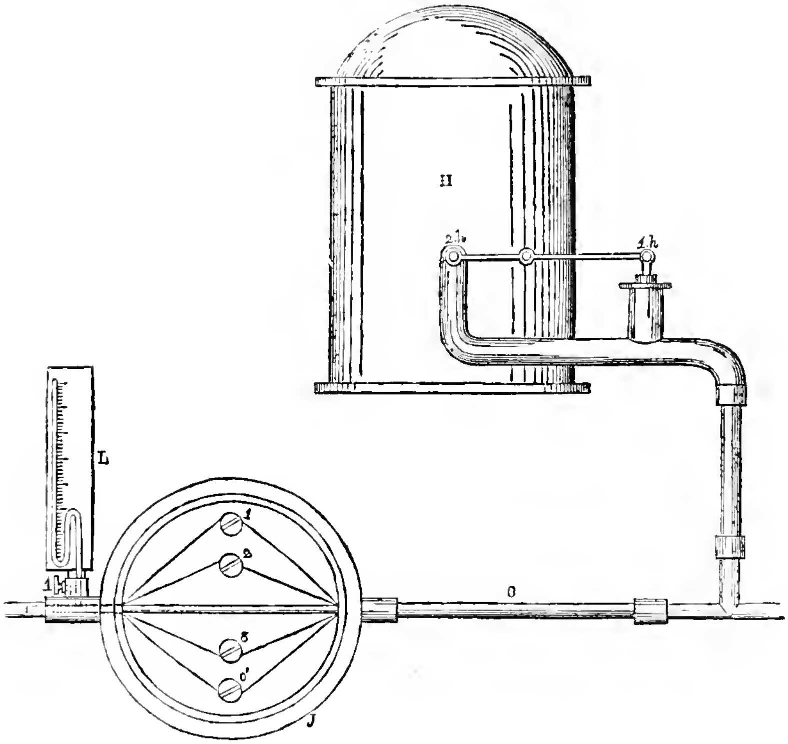


Fig. 11. Air-pressure apparatus, employed for excluding water from the tube, when carried underground; and for giving notice of defects in the tubing.

H is an air-pressure apparatus, or air reservoir, of convenient size, charged with dry air to any pressure. 1 *h* is a pressure balance, in the form of a lever; 2 *h* a valve communicating, by a minute opening, between the reservoir H and the protecting tube C. Suppose it to be found desirable to keep the interior of the tube under a pressure of two or three pounds (that being calculated as sufficient to exclude the greatest pressure of water to which the tube is liable), the balance 1 *h* must then be loaded to that amount; on any escape of air taking place from the tube, the lever arm, 1 *h*, would descend and open the valve 1 *h*, till the high-pressure reservoir had increased the pressure of the tube, which by raising the pressure-balance 1 *h*, would close the valve 2 *h*. A barometer, L, may indicate the change of pressure either in the reservoir or tube. The reservoir is supplied by an air-pump, when nearly exhausted by any leakage, which, under the light pressure of two or three pounds, should be very trifling. Should the barometer, however, indicate a sudden escape of air, attention must immediately be directed to the proving-boxes J, which occur at short intervals along the line.

In or near the box, conveniently connected with the tube, is a three-way stop-cock, to the pipe of which a portable barometer or detector, L, can immediately be applied. When the tube is faulty, upon turning the cock in one direction, the pressure on the barometer will remain steady, but in the other direction it will rapidly diminish, from the escape of the air. By proceeding with a similar experiment at other proving-boxes, the two boxes will be readily ascertained between which the escape of the air takes place; when the tube lying between the last proved points must be carefully examined to discover the faulty part.

THE ARTESIAN BORING AT PARIS.

In the Journal for April last, we gave an account of the successful operations in sinking the Artesian well at Grenelle; we are now enabled to furnish some farther detail of the geological formation through which the boring passed, from the observations of M. Mulot given in the *Revue Générale*, together with some additional information as to the size of the bore, and the geological character of the circumjacent country.

Table of the depths of the strata measured from the surface in metres and reduced to English feet.

Metres.	Feet.	
10	33	Alluvial formation, the former bed of the Seine.
41	134	Plastic clay and quartzose sand.
140	459	White chalk with black flints.
165	541	Gray chalk and flint.
506	1660	Gray chalk, very hard, with layers of micaceous clay.
546	1791	Blue clay, green clay, micaceous black clay, with fossils and iron pyrites.
547	1794	Argillaceous green sand.

Beyond here the sand continues and has not as yet been quite explored, it is in this stratum that the water is obtained.

The boring was commenced at a diameter of 0·51 metres (20 inches) and diminished by degrees as the tubes descended, the first four columns of tubing diminishing as just observed, to the depth of 145 metres (576 feet); at this point the diameter was 0·31 centim. (12 inches).

A 5th column of tubing goes down to 350 metres (1148 feet), with a diameter of 0·26 (10 inches.)

A 6th to 410 metres (1345 feet) diameter 0·21 ($8\frac{1}{4}$ inches.)

A 7th to 540 metres (1771 feet) diameter, 0·17 ($6\frac{3}{4}$ inches).

The last 7 metres (23 feet) are not tubed.

The fixing of the ascensional tube is always an operation very important and delicate, and will on this occasion in particular present serious difficulties. Indeed one would suppose that it was almost impossible to lower perpendicularly a tube 547 metres (1794 feet) high into the earth, but from M. Mulot's skill, of which he has given so many proofs during the work, we are completely assured of its final success.

The quality and kind of metal which composes the ascensional tube have been studied by persons interested in the construction of the well; for many tubes of this kind have been constructed of wrought iron, and have not answered the expectations of the parties interested. A remarkable instance may be cited which happened at Saint Cyr, near Tours, at Dr. Bretonneau's artesian well. The water there rises from the sand beneath the chalk, and was tubed with iron, yet every successive year the quantity of water was sensibly diminished, and at last gave only an insignificant supply. M. Bretonneau caused the tubing to be drawn up, and although it had at least a thickness of 8 millim. ($\frac{3}{10}$ of an inch) and was well preserved, yet at the joints of each pipe there was one, and sometimes several circular holes two and even three centim. diameter, (about an inch diameter,) of which the edges were perfectly sharp, as though they had been cut out by a pair of nippers. This phenomena was probably due to an electro-chemical action, and it shows that iron ought to be entirely rejected in the construction of ascensional tubes. Tubes of oak or elm are certainly those to which preference is always given; but the thickness which is indispensable for them, would diminish the interior diameter too much in the Grenelle well. Copper tubes of a thickness of two or three millim. (about $\frac{1}{10}$ of an inch), not only possess a sufficient resistance, but also the property of being indestructible. It is with these latter, therefore, that the Grenelle well is to be tubed.

Independently of the importance of M. Mulot's undertaking for the useful purposes to which it may be applied, it is also of great interest for the geological study of the strata through which it traverses with regard to the central heat of the globe. Taking as our starting point the constant temperature of the cellars of the Observatory, which are 28 metres (91 feet) deep, the temperature would present a uniform increase of a degree centigrade for every 32 metres (105 feet) in depth. The temperature of the water of this well has been calculated at about 27·6 Cent. (8·17 Fahr.)

The cretaceous formation, passed through by the well of Grenelle, has been deposited in successive layers in an immense basin, formed by the formations anterior to this part, of the secondary formation; the borders of the inferior strata of the chalk formation, crop out in many places, some on the edges of the basin and others a little below the soil; they not only receive the infiltrations of the rain water, but also those of rivers that flow over the exposed strata. A complete identity has been found to exist between specimens of brown free stone and green sand obtained in very different places, and very far one from another, and specimens from M. Mulot's boring. At Lisieux in Normandy, the inferior part of the cretaceous formation reposes on the Jura formation;—the limit of which formation extends towards Mans and La Flèche, and receives in this part considerable infiltrations from the Loire, which flows direct upon it N. E. of Angers. The Loire ought also to furnish water to the lower part of the formation near Saumur; the boundary then passes south of Paris by Loudun, Châtellerault, to the north of Bourges, and then to Sancerre. In all these different localities it receives the waters of the Vienne, Creuse, Indre, Cher and Loire; at Sancerre this limit takes a northeast direction passing near Auxerre, Joigny, and Troyes, and receiving the waters of the Yonne, Seine, Aube, and a great many other rivers of less importance. Near Troyes,* at Lusigny, and at the Abbey of Monster-Rancey, at four leagues south-east of Troyes, the brown free stone and the green sand crop out. In its northern direction through Sainte-Menehould this boundary receives the waters of the Aisne very considerably. Lastly, this formation forms the bottom of the tertiary formation of Belgium, where it receives other infiltrations that feed the Artesian wells of Picardy and Artois, &c.

All these waters filter freely enough through the sand of the cretaceous formations, and from thence pass and accumulate at the bottom of the basin, continuing to be in direct communication with the points of infiltration. As these points are so much elevated above Paris, the waters rise, and will rise still more in the Grenelle well when it is completely tubed, to a height which will be a measure of the amount of pressure exercised on the layer which forms as it were the roof of the bottom of the basin.

ON THE GIVING WAY OF EMBANKMENTS.

The following remarks on the giving way of embankments, by M. Colin, principal engineer of the bridges and embankments of one of the largest canals in France, are the results of many years practical acquaintance with the subject.

The first appearance presented by a slope that has given way is that of an alteration more or less complete of its primitive form, whether natural or artificial. On examining the facts which strike the eye of the observer it must be at once admitted that the cause of the fall of a mass of moving earth must have operated either at a certain depth, or near the surface of the slope; therefore it is requisite, in all cases, to distinguish the superficial slips of earth from those that have a deeper origin.

When a mass of homogeneous earth is composed of argillaceous matter, which is liable to give way, the strata may be more or less inclined to the horizon. When the slip occurs on a pre-existing surface, the following considerations will not be applicable; the slips of this kind are very rare, and are only accidental occurrences, which we should be careful not to confound with the general facts examined by M. Colin.

The mass of fallen earth whether natural or artificial, could not have been in a state of equilibrium in relation to the cohesion of its particles, which on the one hand tended to hold it together—and to gravity, which, on the other hand, tends to destroy the cohesive attraction. When this equilibrium is destroyed it must happen that the slope, or a part of it, will experience a spontaneous fall.

When by the action of the fall the moving mass is detached at such a depth that it preserves its central cohesion notwithstanding the fracture, which has destroyed the cohesion only on the surface of the slip, and notwithstanding that relative alteration in the angle of the strata which compose that mass,—in such case the cause of the slip must be pronounced to have proceeded from below, in contradistinction to that fall which occurs when the moving mass is detached nearer the surface, and when the cohesion of the mass is more or less destroyed by the action of external agents. It often happens, however, that both these kinds of slip occur at the same time.

This characteristic difference depends on the chemical nature of the soil, so that the same kind of slope may in one case experience a falling away from the surface alone, when in another case the cause of the slip may be more deeply seated.

There is another important difference between slips of earth proceeding from the surface and from below, which is, that the extent of the former is immediately known, while that of the latter may go on gradually increasing, according to the influence of rain, frost, and thaw. In every case, however, it is the action of gravity which causes the disturbance of the equilibrium; for the destruction of cohesion by the external agents is only an action eminently statical; the force of gravity alone causes the movement. It is therefore natural to infer, that as the principal cause of the destruction of the equilibrium is the same in all cases, the dynamical results must also be the same. Consequently the surfaces of slips, whether they proceed from below or from the superficies, ought, theoretically speaking, to be of the same kind, and to present, as regards their material points, a striking resemblance.

On examining with great care the general facts concerning these two kinds of spontaneous slips of earth, the angle of inclination of the falling earth, and that of the surface on which it falls, and comparing them with a great number of facts collected in various places, with different kinds of soil, and under different circumstances, by other engineers, as well as by M. Colin himself, he thinks he has established as a principle the following proposition:—

"When masses of earth nearly homogeneous, whether natural or artificial, are composed of such materials that the action of gravitation may, under the influence of certain physical circumstances, overcome the cohesion of their molecules, the results are spontaneous movements, which are called slips. These movements are independent of the height of the slopes on which they occur; they always present, nearly in the same degree, the character which appertains to them; lastly, and above all, the natural surface of separation, or the surface of the slip, has no pre-existence, and possesses a constant and regular form, which approaches more or less exactly, according to different circumstances, to a surface of a cycloidal shape, which brings the causes of its formation essentially within the domain of mechanical science."—*Inventors' Advocate.*

HEREFORD CATHEDRAL.

The public are already aware that very extensive improvements have for some time been going on in this beautiful edifice under the superintendence of Mr. Cottingham, the celebrated architect. We have already described the various restorations in the choir, Lady Chapel, &c., but all the interest in these (and it has been very great) is altogether lost in the discovery by the architect that the tower of the cathedral, with its immense superincumbent weight, is in imminent danger of falling, and crushing the mighty fabric in one general ruin. Before entering into a somewhat technical description (which may perhaps be understood only by a few) of the appearances that lead to this conclusion, we may observe, that we have examined the present state of the tower most minutely, and the fissures in the masonry at the angles of the Norman arches of the transepts are truly frightful. In some places the workmen may insert a piece of wood or any implement to the depth of two feet; and we particularly noticed that one of the stones forming the masonry had given way, not at the joining, but in the solid part itself, being literally split in two. It appears that some cracks in the chief wall of the tower led Mr. Cottingham to examine into the cause. He accordingly proceeded first to ascertain the state of the main piers below in the body of the church, and these he found to be all solid. He next explored the masonry of the unsightly piers under the Norman arches of the north and south transepts, and ascertained that the arch was quite independent of this enormous body of masonry; that is, that the Norman arch had "stuck firmly to its work," and that, as has long been suspected, the piers were no support whatever. Mr. Cottingham next examined the string course round the bell chamber, which supports the 52 solid stone columns above that chamber, and he found that this course (or wall, as we should call it) was rounded in the centre, and dipping down at the angles of the tower. This proved that the ancient Norman arches were still in their original position, and that the fractures which now exhibited themselves in every direction were occasioned by some defect in the main piers of the tower. On taking up the bell-ringers' floor, Mr. Cottingham found the stone groining (which was put up about the time of Edward IV.) also pressing upon the four angles of the tower. It is singular that the "pockets," or angular spaces of this groining, were filled up to the level of the floor with solid rubbish. On removing this, a most extraordinary failure in the masonry fully developed itself. At each end of the four angles was a hollow chamber running diagonally through the main wall, which, from the pressure of the enormous stone piers above alluded to, was crushing in in every direction. All the bond of the interior ashlering was ascertained to be broken, and the stones fractured into innumerable pieces; indeed, the failure is awful to contemplate, and we may congratulate the public that the discovery was made previously to any further pressure, which must have occasioned the total destruction of this magnificent tower, together with the choir, the transepts, and the eastern portion of the nave. When, or

* The specimens from Lusigny were presented by M. Volfardric, who observes that the height of the well above the level of the sea is 130 metres, whilst that at Paris is only 31 metres.

IRON ROOF OVER THE RAILWAY STATION OF THE VERSAILLES RAILWAY AT PARIS.

Fig. 1.—Section of upper part of Roof.

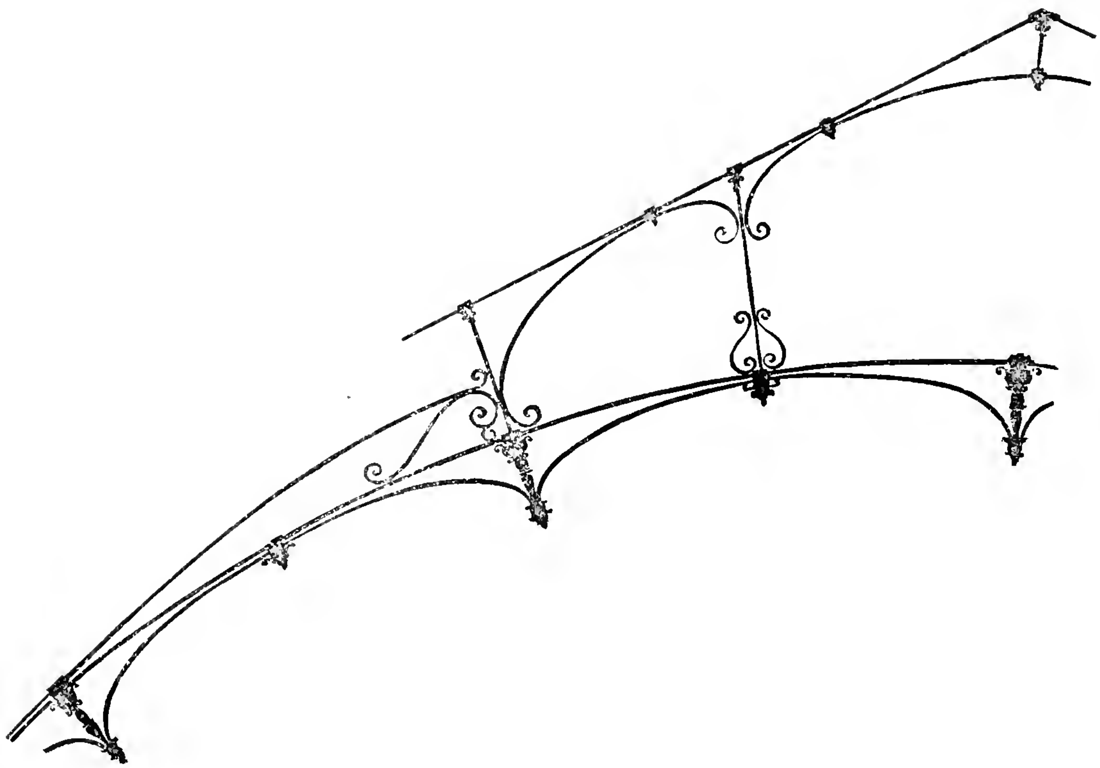


Fig. 3.—View of Railing supporting Skylight.

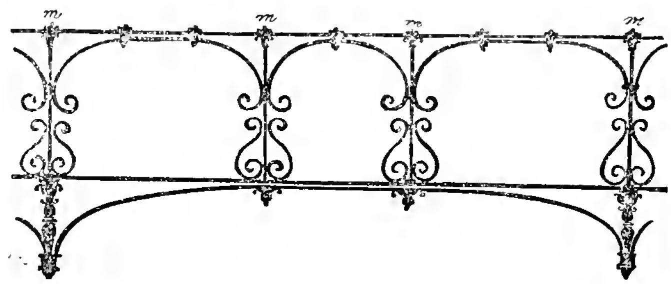


Fig. 2.—Section of the lower part of Roof.

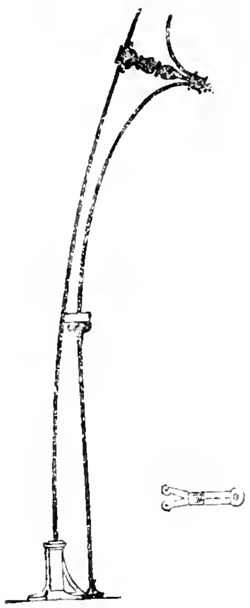
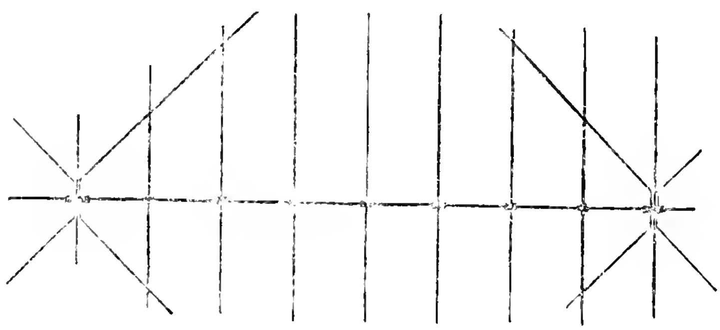
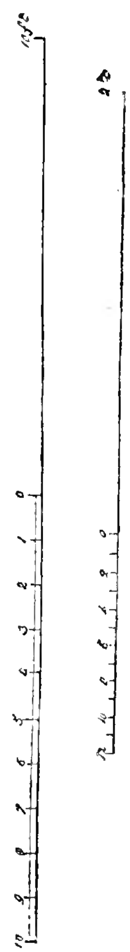


Fig. 5.—Plan of Rafters.



Scale of Feet. Figs. 1, 2, 3, 4.

Scale of inches and feet for detail.

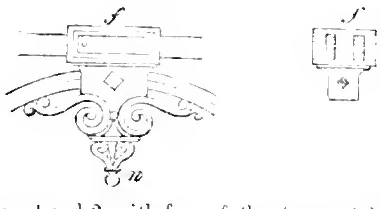


RAILWAY STATIONS.

The Revue Generale contains a description of several Railway Stations both in England and on the Continent, illustrated with details of their construction, from which we extract the following information relative to the Paris Station of the *Left Bank Versailles Railway*, situated near the barrier of Maine.

The terminus of the railway is on an embankment 23 feet high, which offers serious impediments to the construction of buildings, turn tables, and other works requiring solidity. The terminus consists of three ways with a platform on each side for the passengers on their arrival and departure. The whole of this was covered over with a semicircular roof of iron, which fell down soon after its construction, during a hurricane on the 16th of September last. The semicircular form without any stays forming direct angles is at all times a bad mode of constructing buildings, where they are subject to the powerful action of the wind, as its force impinging upon any part is transmitted through the whole, and when successive gusts of wind are continued, this transmission of the force becoming more and more formidable like a wave in a tempest, must in the end lead to the destruction of any building that is built of such slender materials as the one now before us. The roof possesses considerable ingenuity in its construction, for its lightness and elegance of its form, we shall therefore notwithstanding its failure, proceed to give some account of its construction.

Fig. 5.



The roof is of a semicircular form 161 feet long, and consists of 13 main ribs or arches placed 12 ft. 6 in. apart in the clear, 10 of which were 57 feet span, and three at the extreme end of the station 70 feet span. A section of the roof is represented in figs. 1 and 2, with four of the tangential curvilinear stays omitted. The main ribs spring from an upright cast iron base (fig. 2,) standing on the timber piles which carry the passengers promenade platforms, these piles are tied across the railway transversely at about 4 feet below the top of piles, or 3 feet below the surface of the rails by strong wrought iron ties, to prevent them spreading. The ribs are composed of 5 bars of wrought iron up to the top of the column, fig. 2, the two external bars ½ inch by inch, the two next ½ by 1½ inch, and the centre 1½ by 2 inches, all bolted together; above the column and up to about two-thirds the height they have only 4 bars, omitting the centre, and the remainder have only the 2 external bars. These ribs are strengthened by tangential curvilinear stays, consisting of wrought iron bars ¾ inch square placed diagonally and secured in the centre by the ornamental coupling *n*, fig. 5, and at each end by the pendant *x*, shown more in detail in fig. 6, and secured to the main rib. There are also similar tangential curvilinear stays springing from the same pendants at right angles to carry the purlin bars as shown in the lower part of fig. 3, for the support of the rafters and covering, the lower tangential stays abut upon the top of the wrought iron column 1½ inch diameter (fig. 2). The pendants (fig. 6.) consist of a cast iron baluster, the 2 bars of the main rib passing through the head (*a*), and also at right angles the purlin bar. The 4 ends of the tangential bars are secured in the holes at the 4 angles of the base *c*, which is hung up to the bars of the rib by a nut and screw bolt passing through the centre of the pendant; the d an *c'* shows the position of these holes, that in the centre receiving the bolt just described, and those at the 4 angles the tangential stays; the drop *e*, with the collar *d*, is fastened on to the top of the pendant and conceals the bolts, the bottom part of the baluster fits in with the conical shaped end (*b*) into the embrasure (*c*).

Fig. 6.

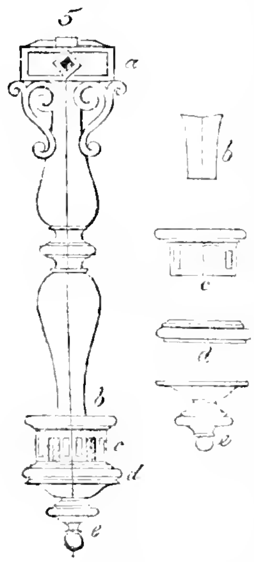


Fig. 7.

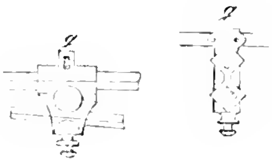


Fig 8.

The purlin bar and the curvilinear stays were secured by the coupling *g*, fig. 7, and fig. 8 shows the coupling of the purlin and the rafter *h*, which were of wrought bars 3 by ¾ inch placed 18 inches apart, as shown in fig. 4. The covering was of galvanized sheet iron laid with a folded seam similar to zinc.

The upper part of the roof was covered entirely by a skylight, laid to an angle of 25°, the lower part was supported by the light ornamental iron work shown in fig. 3, supported by the tangential stay bars.

We here give the weights of the principal parts.

Base of the column	5 lb.
Capital	9¼ lb.
Pendants of cast iron	26 lb.
Great S shaped guard of the lantern	36¼ lb.
The parts *m*	10½ lb.
n	7¾ lb.
o (cast iron)	7¼ lb.
p	3¾ lb.
h	¾ lb.

The total weight of the casting of the roof was 5 tons 6 cwt.

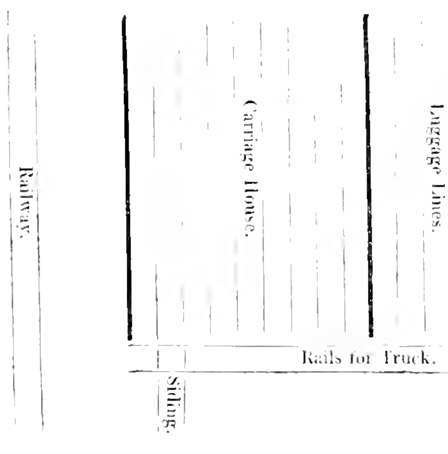
That of the other iron work 13 tons 5 cwt.

The total cost including painting and glazing was 25,000 francs, (1000*l*.), and as there were about 1000 square yards of surface, that gives 1*l*. per square yard covered, undoubtedly an exceedingly low price.

It will be seen from the preceding description what a great number of cast iron pendants and couplings compose this roofing, but at the same time that the different shapes are not numerous, and that the models are few. In wrought iron in order to obtain this variety of shape, it would have been requisite to have forged each piece separately, and to have had much manual labour. It will be further perceived that all the pieces are simply cut in lengths, without being re-forged or filed. The iron on coming from the forge, is bent cold according to the form required, and then fixed in the cast iron pendants by means of bolts, so that it is not necessary to employ iron of superior quality that can be worked hot: it is only necessary that it should not be cold short. It is this arrangement to which we principally wish to call attention, as it is the reason which has induced us to publish the preceding description, as an instance of an iron roof easily put together and composed of a minimum weight of cast and wrought iron. It will be seen that such work can be made at a distance and then put up on the spot. It is only necessary to send the pendants and couplings, and the bars of rough iron, which are to form the roof, and which can be cut up on the spot, and bent according to circumstances. As the coupling pieces are of cast iron, ornaments can be introduced in the casting, and an elegant appearance given without much expense. With these advantages had M. Fauconnier designed it with lines so as to have formed geometrical figures of fixed position, we have no hesitation in saying that it would have been a most remarkable work.

At the same station for the purpose of communicating between the main rails and the carriage house, which is parallel to them, a siding is carried from the main line to the front of the carriage house, as shown in fig. 9. The latter contains four lines of ways running from

Fig. 9.



from front to rear, and outside of it are five more lines of way for the luggage trucks. Along the front of the carriage house, and at right angles with the rails is a pair of rails laid to a gauge of 7 ft. 4 in., and 9 inches below the lines of way, upon which runs a carriage, shown in figs. 10 and 11. On the top of this carriage, and on a level with the

Fig. 10. Plan of Truck.

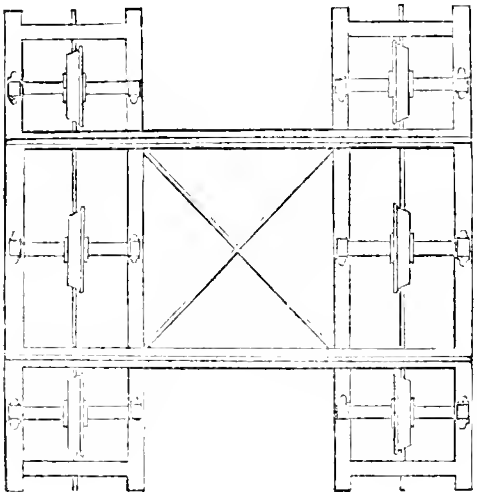
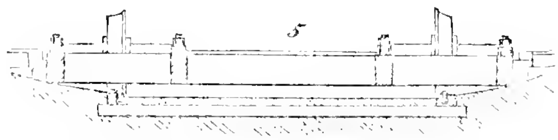
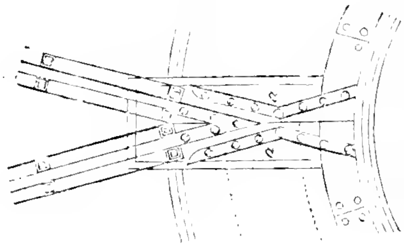


Fig. 11. Section of Truck.



rails of the main line are corresponding rails supported on timber framing, which is suspended to the axles of six cast iron wheels, 20 inches diameter. These wheels run on the 7 ft. 4 in. gauge for the purpose of removing the carriage or truck which is put upon the frame to any pair of the reserve rails in the carriage-house. This saves the trouble and expense attendant upon turn tables opposite to each pair of rails.

Fig. 12.



The engine house is a polygonal building containing twelve lines of way, in the middle of which is a turn table communicating with the whole. The construction of the points is shown in the annexed figure 12.

Glass Cloth Weaving.—A most ingenious artist, a Mr. Barker, from Ossett-street-side, is now exhibiting the process of this novel species of manufacture, in a room in the Philosophical Hall, Halifax. He has lately forwarded a most splendid apron, and a pair of slippers, to her Majesty the Queen, which have been most graciously received, with the strongest approbation. We have seen some very beautiful specimens of the ingenious inventor's skill, and consider them as splendid novelties. We particularly noticed a piece of waistcoating, two and three quarters yards long, and half a yard in width, which he states to be the first of the kind he has been able to bring to any degree of perfection, and has been woven in Huddersfield. It is beautifully figured like damask or fancy work. One remarkable circumstance in glass cloth is that it will stand washing. We were shown a piece of pure white, which has six times undergone that process. We hope the ingenious and persevering man who has already spent two years and a half in bringing his invention to a state fit to meet the public eye, will reap his reward for his invention.—*Halifax Guardian.*

ON THE ECONOMY OF FUEL IN LOCOMOTIVES CONSEQUENT TO EXPANSION AS PRODUCED BY THE COVER OF THE SLIDE VALVE.

Sir—With a view to economy of fuel, locomotives are now generally constructed so that the slide valve shall have what engineers call "cover on the steam side," the effect of which is, that steam is admitted to the cylinder during only a part of the stroke of the piston, and during a part of the remainder that steam by expanding to occupy a greater volume propels the piston; which expanding increases the work performed by a given quantity of steam to an extent depending on the ratio of that part of the stroke, during which the steam is admitted to the cylinder, and that part of it during which the steam is expanding; and as the consumption of fuel is dependent on the work performed by a given quantity of steam, an analytic investigation of the cover of the slide valve is the object of the following.

In the figure* let F′ G, represent the connecting rod, F′ E the engine crank, E A′ the eccentric crank, F E the engine crank when the piston commences its stroke, and E A the corresponding position of the eccentric crank, B C, D C valve levers. Put E A′ $= a$, E F′ $= d$, cover of valve $= c$, lead of valve $= l$, B C $=$ D C. To diminish complication neglect the radiation of the eccentric rod and connecting rod, which may be done without sensible error, since their length is great in proportion to the lengths of the cranks.

Draw L E perpendicular to E B, and any angle L E A has its sine proportional to the distance that the valve is from its position when L E A $= o$. When the piston is commencing its stroke the valve is open, the quantity (l), and therefore it has travelled the quantity $(l + c)$ from its position when L E A $= o$; hence $a \times$ sin. L E A $= l + c$

$\therefore$ sin. L E A $= \frac{l + c}{a}$, and cos. L E A $=$

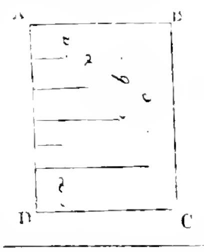
$$\sqrt{\left(1 - \frac{(l+c)^2}{a^2}\right)}$$

Again, if the engine crank travels over any angle (φ) from its position, F E the descent or progress (y) of the piston is equal to $d \times$ versin φ, $\therefore$ cos. $\varphi = 1 - \frac{y}{d}$, and sin $\phi = \sqrt{\left(\frac{2y}{d} - \frac{y^2}{d^2}\right)}$. The travel (x) of the valve corresponding to the travel (y) of the piston, is equal to $(a$ sin. (L E A $+ \varphi) - a$ sin. L E A), $\therefore \frac{x}{a} =$ sin. L E A cos. $\varphi +$ cos. L E A sin. $\varphi -$ sin. L E A, and by substituting for the functions of the angles their values found above, and reducing we get

$$x^2 + 2x(l+c)\frac{y}{d} = a^2\frac{2y}{d} - a^2\frac{y^2}{d^2} - (l+c)^2\frac{2y}{d},$$

an equation expressing the relation of (x) and (y) in terms of known quantities.

When the piston begins its stroke the valve is a little open, and steam continues to enter until the valve in its retrograde motion shuts the passage; expansion then commences and continues until the eduction passage is opened. When the eduction passage is opened on one side of the piston it is shut on the other, which gives rise to the compression of steam on the educted side of the piston, and this compression continues until the valve opens for the lead of the next stroke.



In figure let A B C D be a steam cylinder, stroke $=$ A D $= 2d$, $a' =$ distance from commencement of stroke to commencement of expansion, $b =$ distance from commencement of stroke to end of expansion; $c' =$ distance from commencement of stroke to position of piston when the valve opens for the lead of next stroke. To find by the above equation the travel of the valve corresponding to the travel (a') of the piston substitute $x = -l$, for the travel corresponding to (b) $x = -(l + c)$, and

* The figure is not quite correct; the line should be drawn [illegible] and not from f' to a'.

for the same in relation to (c') $x = -(l + 2c)$. And we have

$$x = -l \text{ and } y = a' = \frac{d(a^2 - lc - c^2) + d\sqrt{(a^2 - lc - c^2)^2 - a^2 l^2}}{a^2} =$$

$$d(1 - lc - c^2) + d\sqrt{\left\{(1 - lc - c^2)^2 - l^2\right\}}. \quad \text{When } a = 1$$

$$x = -(l + c) \quad y = b = \frac{a^2 d + d\sqrt{a^4 - a^2 (l + c)^2}}{a^2} = d + d\sqrt{1 - (l + c)^2}$$

$$x = -(l + 2c) \quad y = c' =$$

$$\frac{d\left\{a^2 + lc + c^2\right\} + d\sqrt{\left\{(a^2 + lc + c^2)^2 - a^2 (l + 2c)^2\right\}}}{a^2} =$$

$$d(1 + cl + c^2) + d\sqrt{\left\{(1 + cl + c^2)^2 - (l + 2c)^2\right\}}$$

Having now found the values of $(a'$ b and $c')$, we must next find the effect gained by the expansion of the steam from $(a'$ to $b)$, and the effect lost by the compression of the steam from $(b$ to $c')$. But expansion may take place in two ways, the operations of which are quite distinct, first, the cylinder may remain of the same volume and the steam be increased in pressure before entering them; or, the cylinders may be enlarged and the pressure of the steam be constant, which is the plan virtually adopted in locomotives; for those of them that do not work by expansion when properly constructed, are so made that their cylinders are not capable of consuming a greater volume of steam than the boiler can furnish of the greatest safe pressure.

The eduction passage being shut by the time that the piston arrives at the end of (b), saves, or at least prevents from flying to the atmosphere a quantity of steam of a pressure (t), that fills $(2d - b)$ of the cylinders, which at a pressure (p) would fill $\frac{(2d - b)t}{h}$ of the cylinders hence when the steam is cut off at (a'), there is only admitted so much fresh steam as fills $(a' - \frac{(2d - b)t}{h})$ and since the quantity of fresh steam admitted must (whatever the expansion is) be constant, we have $s\,(a' - \frac{(2d - b)t}{p}) = 2d \times 1$, $\therefore s = \frac{2dp}{a'p - 2dt + bt}$, (s) being the area of the piston.

Again in figure let (x) be any portion of the stroke greater than (a), and less than (b), and let p' be the pressure into which the steam has expanded at the end of (x) then $x : a' :: p : p'$, $\therefore p' = \frac{ap}{x}$ $\therefore$ effective working pressure $= \frac{ap}{x} - t$.

$\because$ differential of work performed $= d$ efficiency $= s\,(\frac{ap}{x} - t)\,dx$,

$\therefore$ efficiency in part (b) of the stroke $= s\,ap\,(\log \frac{b}{a} + 1) - s\,t\,b$.

Again, for the effect of compression caused by the shutting of the eduction passage let (x) (measuring from D C) be any portion of the stroke between $(b$ and $c)$, and (p') the pressure, to which the confined steam has been compressed, then $x : 2d - b :: t : p'$ $\therefore p' = \frac{(2d - b)t}{x}$, $\therefore$ effective working pressure $= \frac{(2d - b)t}{x} - t$ $\therefore d$ efficiency $= \left(\frac{(2d - b)t}{x} - t\right) s\,dx$, $\therefore$ whole effect of compression $=$

$$s\,t\,(2d - b)\left\{\log. \frac{2d - b}{2d - c} - 1\right\} + s\,(2d - c)\,(p + t.)$$

By deducting the effect of compression from the efficiency of the part (b) of the stroke, we have whole work performed $=$

$$s\,a'p\left(\log. \frac{b}{a'} + 1\right) - s\,t\,b - s\,t\,(2d - b)\left\{\log. \frac{2d - b}{2d - c} - 1\right\}$$

$- s\,(2d - c)\,(p + t)$. Put $2d = 1$, $t = 1$ and (p) is then expressed in multiples of (t). $\therefore$ whole work performed $=$

$$s\,a'p\left(\log. \frac{b}{a'} + 1 - s\,b - s\,(1 - b)\left\{\log. \frac{1 - b}{1 - c} - 1\right\}\right)$$

$- s\,(1 - c)\,(p + 1)$.

$$\text{But } s = \frac{p}{a'p - 1 + b}$$

$\therefore$ Whole work performed $= \frac{p}{a'p + b - 1}$ multiplied into

$$\left\{a'p \log. \frac{b}{a'} - (l - b) \log. \frac{1 - b}{1 - c} + a'p - 2b - p + pc + c.\right\}$$

An expression for the work performed by a unit of volume of steam, formed of known quantities, or rather of quantities which become known when (l) the lead, and (c) the cover of the valve are given.

Let the safety valve be so loaded that (p) is equal to (s), and let the lead (l) of the slide valve be nothing, and the cover (c) be nothing. Then $a' = 1$, $b = 1$, $c' = 0$, $\therefore$ whole work performed $= p - 1 = 4$, which is exactly what another mode of proceeding gives for when the valve has no cover and no lead, the work performed is evidently $= 2d\,(p - t)\,s$. But $2d = 1$, $t = 1$, and when the valve gives no expansion $s = 1$, therefore work performed $= p - 1 = 4$.

Again, let the lead (l) be equal to $\frac{1}{6}$ of the breadth of the port, and the cover (c) equal to $\frac{1}{4}$ of the breadth of the port. And then
$a' = 0{\cdot}888$ $b = 0{\cdot}9545$ $c' = 0{\cdot}992$ $\therefore$ whole work performed $= 4{\cdot}2378$.

Again, let $l = \frac{1}{6}$ breadth of port, $c = \frac{1}{2}$ breadth of port, and then
$a' = 0{\cdot}656$ $b = 0{\cdot}873$ $c' = 0{\cdot}99$ $\therefore$ whole work performed $= 4{\cdot}8966$.

Again, let $l = \frac{1}{6}$ breadth of port, $c = \frac{3}{4}$ breadth of port, and then
$a' = 0{\cdot}2881$ $b = 0{\cdot}7$ $c' = 0{\cdot}975$ $\therefore$ whole work performed $= 7{\cdot}1$.

Again, $l = \frac{1}{100}$ breadth of port, $c = \frac{3}{4}$ breadth of port, and then
$a' = 0{\cdot}43$ $b = 0{\cdot}825$ $c' = 0{\cdot}999$ $\therefore$ whole work performed $= 1{\cdot}97$.

Hence the following conclusions:—In a locomotive in which the stroke of the cylinder is 18 inches, and breadth of port $1\frac{1}{2}$ inches, if the work it performs with a ton of coke when the valve has no cover be called 1; then by giving the valve $\frac{1}{4}$ of an inch of lead, and $\frac{3}{8}$ of an inch of cover, the steam will be cut off at 15·98 inches from commencement of stroke, and the work performed by a ton of coke will be 1·0591.

Again, by giving the valve $\frac{1}{4}$ of an inch of lead, and $\frac{3}{4}$ of an inch of cover, the steam will be cut off at 11·8 inches from commencement of stroke, and the work performed by a ton of coke will be 1·2211.

Again, by giving the valve $\frac{1}{4}$ of an inch of lead and $1\frac{1}{8}$ inches of cover, the steam will be cut off at 5·2 inches from commencement of stroke, and the work performed by a ton of coke will be 1·75.

Again, by giving the valve $\frac{1}{100}$ of the breadth of the port of lead, and $1\frac{1}{8}$ inches of cover, the steam will be cut off at $7\frac{5}{8}$ inches from commencement of stroke, and the work performed by a ton of coke will be 1·242.

In the two last examples the cover of the valve is the same, but in the latter the lead is much less than in the former, which has diminished the efficiency of a ton of coke from 1·75 to 1·242, or nearly in the ratio of 3 to 2; and if the lead was still a little less the advantage gained by the cover would be altogether neutralized. Hence it appears that the lead is an important feature in the construction of the slide valve, and might be a good subject of enquiry as to what relation it ought to bear to the cover so as not to interfere with the operation of expansion.

I am, Sir, your obedient servant,

J. G. LAWRIE.

Cartsdyke Foundry, Greenock,
June 27, 1841.

N.B.—Should you consider this letter worthy of insertion in your Journal, I shall probably request insertion of another in continuation of the same subject, in which the lead will come under consideration.

J. G. L.

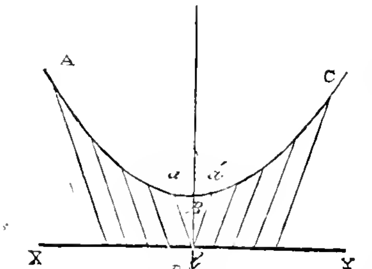
REMARKS ON MR. DREDGE'S SUSPENSION BRIDGE.

SIR—Feeling some interest in the subject of suspension bridges, I was gratified to find in a recent number of your instructive publication, a description of Mr. Dredge's newly invented suspension bridge, represented as offering such superior advantages, in all the essential particulars of strength, durability, and economy of construction. At the same time, however, I was somewhat disappointed when, having perused the article in question, I found that no attempt had been made to demonstrate the possession of such desirable qualities, by a reference to those well known principles and laws which govern the forces to which a suspension bridge is subject, and not having subsequently seen in the Journal or other publications, any such investigation of the subject, I am induced to forward to you the few remarks which follow, in the hope that you may think them deserving of a place in your forthcoming number.

The two characteristic features of Mr. Dredge's bridge appear to be the unequal thickness of the chains which taper from the middle point of the curve to its extremities, and the inclined position of the suspension rods.

A chain whose thickness is equal throughout being suspended from its extremities, assumes the form of a curve which has received the name of the Catenarian curve; the tension to which the chain is subject by its own weight, varies as the secant of the angle made by the tangent on any point, with a horizontal line, or, which is the same thing, as the secant of the angle contained by the tangent and ordinate. It is obvious, therefore, that the tension will be least at the lowest point of the curve, and increase towards the points of attachment, where it will be a maximum. In a chain of equal thickness its strength cannot therefore be proportionate to the stress to which it is subject, and it therefore naturally occurs that the chain should not be of equal thickness throughout, but be increased in sectional area from the lowest point of the curve to the highest. By mathematical analysis, the form of chain has been determined whose sectional area is always proportional to the tension; and a chain constructed upon this principle has, I believe, been actually adopted for the large suspension bridge erecting over the Avon by Mr. Brunel.

The idea of a chain of varying thickness is not therefore *new*, and as regards Mr. Dredge's bridge, the utility of the form of chain he has adopted appears to depend upon whether the sectional area varies as the tension at each point. Considering the chain in the first instance, as simply affected by its own weight, this point would be determined by comparing its form with that in which it is known the sectional area varies as the tension. I have not at this moment with me the means of making the comparison, but it is evident that if the two forms are identical, there is no *novelty* in this part of the invention, and if they are not, Mr. Dredge has proposed a form which is inferior to one that would always be employed when rendered proper from attendant circumstances. Except in large bridges it has not, however, been considered desirable to vary the thickness of the chain according to the tension, as the difference of thickness at different points is found too inconsiderable to merit attention. It seems, therefore, extremely probable that Mr. Dredge by varying the thickness of his chain in a very rapid ratio has far exceeded the increased thickness required by the tension.



Abstracting now for the sake of argument, the effect produced by the weight of the chain itself, and regarding only that occasioned by the tensions of the rods, it will be observed that these tensions are much increased by the inclined positions which the rods are made to assume. This is illustrated in the figure. A B C is the chain, X Y the horizontal platform, and *a b*, *a' b*, &c. the suspension bars. Let us suppose that the tension of the bars has been adjusted so as to be equal for all, and that the weight of the platform is known. If it be homogeneous in its structure, the centre of gravity will be at *b*, and the weight may be conceived as a force B D, acting in a vertical direction through this point. Each of the pairs of forces acting along the rods *a b*, *a' b*, &c., will have a resultant acting in the direction D B, opposite to that in which gravity acts. These resultants will also be equal to one another, and, supposing the platform suspended from two chains, their sum will be a force equal in magnitude (though opposite in direction) to half the force B D, the weight of the platform. Hence if this weight be given, we obtain the resultant of each pair of forces acting along oppositely inclined rods, by dividing half this weight by half the number of rods attached to one chain. Let the angle made by the rods with the vertical be θ, w half the weight of the platform, and n the number of rods, then the resultant of each pair of forces $= \frac{w}{\frac{1}{2} n}$.

And b the tension of each rod is $\frac{1}{2} \times \frac{w}{\frac{1}{2} n} \times \frac{1}{\cos. \theta} = \frac{w}{n \cos. \theta}$. Hence $b \propto \frac{1}{\cos. \theta} \propto \sec. \theta$, and is consequently least when $\sec. \theta$ is least, *i. e.* when $\sec. \theta = 1$, or the rods are vertical. This arrangement, then, appears disadvantageous, since it not only requires that the rods should be made of increased size to resist the increased tension to which they are exposed, but subjects also the chain to increased pressure from the rods in the ratio of $\sec. \theta : 1$.

Although the forces acting upon the two halves of the chain are inclined in opposite direction, it will be observed that the two halves are precisely similar, for if we imagine one-half to revolve round the axis B D, till the plane in which it is situated, coincides with the plane of the other half, the suspension rods of the two halves will exactly coincide, and consequently as the forces produced by them are equal, coincident in direction, and have similar points of application, the curves produced will be identical in all respects. Being produced by equal and parallel forces uniformly distributed along the curve, they belong to a Catenary whose ordinate is at right angles to the directions of the rods. Hence the tension caused by the action of the rods varies according to the law already stated, and if it be required to equalize the sectional area and tension of the chain, it must be constructed of the form already determined for the Catenarian Curve. Whether, then, we consider the effect of the weight of the chain itself, or the pressures produced by the suspension rods, the chain should be constructed upon precisely the same principles as in the ordinary suspension bridges. For these reasons I cannot but regard the plan proposed by Mr. Dredge as inferior to the ordinary method of construction, and I have accordingly, a contrary opinion having been maintained in your pages, ventured to offer these remarks to the consideration of your readers.

I am, Sir, your's obediently,

G. F. F.

Sandon Bury, July 11, 1841.

MR. PARKES' NEW THEORY OF THE PERCUSSIVE ACTION OF STEAM.

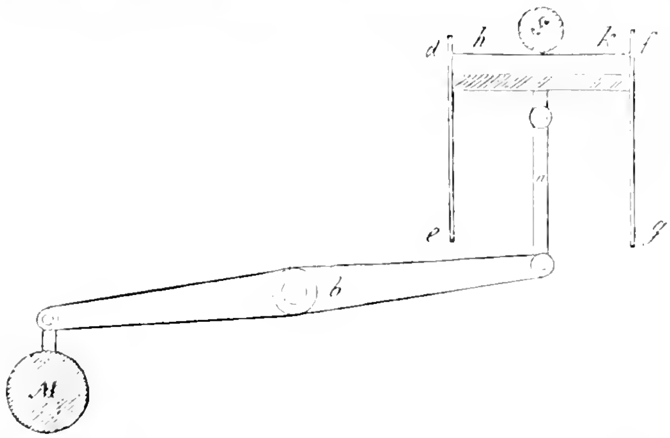
In this highly enlightened age, when long established theories crumble to dust under the all-searching glance of modern science, and the discoveries of our fathers, eclipsed by the surpassing splendour of the productions of modern genius, hide their diminished heads, it would perhaps be a mark of weakness of intellect to express astonishment at any new doctrine, however contrary it may be to our preconceived notions, or apparently so to the fundamental laws of nature. If, then, we were not surprised, at least our interest was excited in a high degree by the perusal of Mr. Josiah Parkes' Paper "on the Action of Steam in Cornish Single Pumping Engines," published in the Transactions of the Institution of Civil Engineers, Vol. 3, Part 4, wherein he developes, or rather announces a new principle of Action of Steam in Cornish Engines, which seemed at the first glance to point out a means of increasing almost indefinitely the dynamic effect of steam in steam engines; though why he considers it to operate in these engines only we know not—we are of opinion, that, if it obtains in them, it should obtain *à fortiori* in Locomotives, where the density and velocity of the steam entering the cylinder are so much greater. This new Principle is denominated by its discoverer the *Percussive Action of Steam*, and is announced in the following words, page 268:

"Steam, in its action on the piston of an engine, has hitherto been considered as simply exerting elastic force."

"Steam, however, possesses another important property, equally inherent in its nature with pressure and expansibility. This property is the velocity and consequent momentum due to steam of high elasticity; a force which comes into play under the peculiar conditions of a Cornish engine. The velocity of steam, in passing from a dense into a rarer medium, is immense; and the momentum of this steam must be very considerable. On the sudden and free communication effected between the cylinder and boiler of a Cornish engine, the steam in the cylinder receives an instantaneous action, proportionate, in amount, to the velocity of the entering steam, and this action, by the property of fluids, is transmitted to the surface of the piston. This action, thus transmitted to the piston, and due to the communication suddenly established between the highly elastic steam in the boiler, and the steam in the cylinder, may be likened, I conceive with great propriety, to the force of percussion; by which term I propose to distinguish it from the action of the steam's simple elastic force."

This force is illustrated in a note at the foot of the page by a comparison with the Pile-driving Machine and Hydraulic Ram; we think the following illustration much more appropriate.

Let *d e f g* in the annexed diagram represent the section of a cylinder, in which the piston *p* can move air-tight, let the latter be connected by a link *a* to one end of the vibrating beam *b*, a mass M being



suspended at the other end; further, let *h k* represent an inflexible circular plate fitting air-tight into the cylinder, but supposed to have no weight, and let there be a space *c* between this plate and the piston *p* filled with air of a given density.

The piston *p* being near the top of the cylinder, the circumstances are analogous to those of the Cornish single-acting engine just before the commencement of the working stroke, the air in the space *c* above the piston representing the cushion of steam against which the piston is brought to rest at the end of the return stroke, the beam *b* the balanced portion of the moving parts of the machinery, and the mass M the unbalanced portion.

In order to form an idea of the manner in which the momentum of the steam, admitted suddenly above the piston at the beginning of the stroke, is transferred to the latter, and thus increases the effect above what is due to the simple elastic force of the steam, let a mass S (say equal to the mass of steam admitted in the stroke) impinge against the plate *h k* with a given velocity. The result of this impact is, obviously, that the mass S loses a portion of its velocity, and consequently of its momentum, which is transferred to the air contained in the space *c*, which in its turn, communicates the chief part of this momentum to the piston *p*, the beam *b* and the suspended mass M. If the mass S be supposed to strike the plate *h k* with a velocity equal to that of the steam at its entrance into the cylinder of the Cornish engine, its percussive effect may be assumed to be the same as that of the latter, though it will in reality be greater on account of the *simultaneous* action of the whole mass, whereas the mass of steam arrives in the cylinder *gradually*. The interposition of the air *c* is essential to the perfect conformity of the two cases, for the entering steam no sooner passes the contracted orifice of the throttle-valve, where it impinges, as it were, against the steam already in the cylinder, than it expands and loses the greater part of its velocity, at the same time compressing the steam with which it mingles.

The necessity of adopting this theory (of the Percussive Action of Steam) was forced upon Mr. Parkes by his inability to discover, in the simple elastic force of the steam employed, an amount of power adequate to accomplish the actual duty ascertained to have been performed by several of the Pumping Engines in Cornwall, the facts observed admitting of no question. This is, in our opinion, the only valid argument brought forward by the author in its favour, though he has adduced several others in corroboration, which, however, require the co-existence of the former to give them weight, and even so they are but of a negative character, amounting in substance to this: since the amount of power due to the steam's elasticity alone is less than the amount of work done, an additional quantity of power must be derived from other source; and whence can it be derived but from the instantaneous action transmitted to the piston, on effecting the sudden communication between the steam in the cylinder and that in the boiler.

Assuming the data furnished by experiment to be correct, (and we have no reason *à priori* to doubt their accuracy), the above reasoning appears to be conclusive, at least in so far as the additional power required to realize the observed dynamic effect must be sought in some property of steam distinct from its elastic force; and its Momentum, or rather Inertia, is the only property which suggests itself as capable of supplying any additional amount of power.

Admitting, therefore, the inadequacy of the simple elastic force of the steam to accomplish the work actually performed, and assuming the deficiency of power to be supplied by the Steam's Percussive Action, the next step naturally, is to examine into the causes and effects of this action.

The cause is obvious, and is almost sufficiently explained in the illustration which we have given above. A mass of dense steam passes through the throttle valve at a great velocity, the chief part of which it loses by the time it comes to act by its elastic force upon the surface of the piston. This mass of steam must, therefore, in losing its velocity, impart its momentum to some other body or bodies, through the medium of which it may afterwards be utilized in increasing the dynamic effect of the steam. The body which receives the shock of the entering steam, and transmits its momentum to the moving parts of the engine, is the steam cushion represented in the illustration by the air *c*, and the entering steam by the mass S. It is this imparting of its momentum which is called the Percussive Action of the steam.

In investigating the effects of this action, our object is to ascertain the amount of momentum transmitted thereby to the piston and other pieces of machinery connected with it, and we looked in vain to Mr. Parkes' work for assistance in this inquiry: there is, indeed, an article (page 269), headed: *Determination of the quantity of Percussive Action*, which commences with the statement that "the dynamic effect, or quantity of action, due to percussion, is discoverable, and assignable for each example: but the only method employed by the author for its determination is that of elimination, that is, by deducting from the total dynamic effect of the steam found in the quantity of work done, the amount due to its elastic force, including expansion, the remainder, which is the deficiency of power according to the ordinary theory, being attributed to the percussive action. In a note at the foot of the same page Mr. Parkes says: "It forms no part of my task to investigate the abstract question of the quantity of this species of force to be obtained from steam; my present purpose is confined to the determination of the effect attributable to it in the three engines subjected to analysis." It is a pity he did not make it part of his task to investigate, not *the abstract question of the quantity of this species of force to be obtained from steam*, but *the practical question* of the quantity which the steam would afford in the three cases under consideration. This inquiry would, doubtless, have been full of difficulties, should the result not turn out to be equal to *o*, which we much suspect would be the case if the investigation were based on the laws of percussion as laid down in the treatises on Mechanics; and if the new principle is to be established in opposition to these laws, it is necessary first to demonstrate their fallacy; but that this is not the view of the case taken by the author is evident by his merely comparing the percussive action of the steam to the shock of a solid body, without intimating in any way that the laws laid down for solid bodies do not obtain equally with regard to steam. He overlooks, however, the important consideration that the shock of the entering steam is not received immediately by the piston, but by the steam previously occupying the space above it, and likewise that the reaction is necessarily equal to the force of impact.

By reason of this latter condition the entering steam can only part with its momentum as fast as the steam in the cylinder is capable, *by its simple elastic force*, to oppose a resistance, or reaction, equal to the force of percussion. The latter is therefore always strictly measured by the elasticity of the steam in the cylinder, the dynamic effect of which thus includes that due to the Percussive Action. If, then, the Indicator diagram exhibits a faithful representation of the elastic force of the steam as it varies from the commencement to the termination of the stroke of the piston, it must necessarily furnish us with the means of determining the whole amount of dynamic effect which can be obtained therefrom. It may also be observed that the effect of the Percussion is transmitted, "by the property of fluids," to the Indicator piston as well as to the working piston, so that, even if there were a Percussive force which acted on the latter in addition to the elastic force of the steam, its influence, being felt by the former also, would be indicated in the diagram by an additional elevation of the pencil.

The above discussion convinced us, as it may also some of our readers, and perhaps Mr. Parkes himself among others, that the difference observed between the amount of power due to the elastic force of the steam and the duty actually performed by the engines subjected to analysis cannot be attributed to the Percussive Action of the steam; and, as there appears to be no other source of power to which it can be ascribed, we are compelled to conclude that the supposed difference does not exist in fact, and consequently that either the experimental data, or the calculations based upon them, are erroneous.

We have said above that we had no reason *à priori* to doubt the accuracy of the observations, and we will therefore now examine into the details of Mr. Parkes' calculations relating to the Huel Towan engine, with the view of discovering whether the discrepancy observed between the power developed by the simple elastic force of the steam and the actual work done be not attributable, either wholly or in part, to some error in his deductions from the data furnished by observation.

Mr. Parkes says (page 261): "The absolute resistance consists of the weight which performs the return stroke, plus the value of engine and pitwork friction, and of the elasticity of the uncondensed steam." To this should be added, for each forcing pump, the weight of a column of water whose base is equal to the sectional area of the plunger and altitude to the mean height of the bottom of the plunger above the level of the water in the cistern whence it is drawn, and for each lifting pump, the weight of the whole column lifted, from the level of the water in the cistern; and we should deduct the amount of assistance, though small, given by the atmospheric pressure on the top of the piston rod.

We are not informed of the value of any of these quantities, except the last, from direct experiment, but we know that the weight which performs the return stroke is necessarily slightly in excess of that of the average column of water raised, augmented by the friction of the water and machinery, and the difference between the atmospheric pressure and that of the steam, during the return stroke, on the area of the piston rod; and the excess (which is necessary to set the engine in motion with its load of water) is counterbalanced at the end of the stroke by the cushion of steam which brings the engine to rest.

Mr. Parkes substitutes for this weight, in his calculations, the water load, which, he says, can alone be termed a positively ascertained quantity; but in computing this load he commits two errors, which, however, compensate each other. He calls the mean diameter of the pumps 14·625 inches, instead of 14·968, which renders it necessary to assume a cubic foot of water to weigh 65·47 lb., instead of 62·5 lb., in order to make the water load equal to 6866641 lb., in which he agrees with Mr. Henwood, by whom the experiment was made. It is permitted, in calculating the effective resistance on the piston, to use the total height of the column of water, since it is equal to the sum of the average heights mentioned above; so that the absolute resistance will be equal to the weight of the total column of water raised, *plus* the friction of the water in the pipes, twice the friction of the machinery, and the elasticity of the uncondensed steam, *minus* the difference between the pressure of the steam during the return stroke, and that of the uncondensed steam during the working stroke, on the area of the piston rod. The diameter of the piston being 80 inches, and that of the piston rod 7 inches, the area of the former minus that of the latter, or the effective area of the piston, is equal to 4988·08 square inches, and the resistance on the piston due to the water load is consequently 11·01 lb. per square inch. (Mr. Henwood by some mistake made it only 10·2 lb. per square inch, which he also called the whole resistance of the engines). The elasticity of the uncondensed steam is estimated at 1·25 lb. per square inch, and that of the steam in the cylinder during the return stroke appears, by Mr. Henwood's indicator diagram, to have been about 6·4 lb. The difference between these two last quantities, reduced in the ratio of the area of the piston rod to the effective area of the piston, becomes 0·04; and we find the whole resistance per square inch of the piston (assuming with Mr. Parkes that the frictions, the actual amount of which we have no means of ascertaining, cause a pressure of 5·75 lb. per square inch) equal to

$$11·01 + 5·75 + 1·25 - 0·04 = 17·87 \text{lb}.$$

We think, with Mr. Parkes, that this amount is by no means exaggerated, but more likely the reverse, particularly in the evaluation of the frictions, and must therefore conclude that the error, if any, must be in the calculation of the power from the indicator diagram. Now we have satisfied ourselves that the mean elasticity indicated by the diagram would not produce sufficient power, so that we have no alternative left but to prove the diagram false or to confess ourselves unable to account for the facts observed by Mr. Henwood.

If we admit the pressures to have been as shown in the diagram, and that the equilibrium value was closed when the piston was 9 inches from the end of the return stroke, we must either suppose the unreasonably large space of 68·059 cubic feet to have existed below the piston at the bottom of its stroke, or, (if we allow thirty cubic feet,) we must assume a waste of 7·1 per cent. of the water expended. On the latter hypothesis, the volume of steam of 6·4 lb. pressure discharged from the cylinder every stroke was 352·886 cubic feet, which is the capacity of the space below the piston when the equilibrium valve is closed, and the volume remaining above the piston was $25·979+c$, calling c the capacity of the space above the piston when at the top of its stroke, or the volume of the steam-cushion. The whole quantity of steam in the cylinder of this elasticity is therefore equal to $378·865+c$, and its relative volume 3668. The space it occupied before the equilibrium valve was opened was $316·393+c$, its elasticity was 7 lb. per square inch, and its relative volume 3377, so that we can find the value of c from the following proportion,

$$32·472 : 291 :: 316·393+c : 3377,$$

whence

$$c = 30·438 \text{ cub. ft.}$$

The absolute volume of the steam which formed the cushion was, before compression, 56·417, and its relative volume 3668; after compression its absolute volume was 30·438, which makes its relative volume 1979, and its elastic force 12·48 lb. instead of 10·7, as shown by the diagram. Mr. Parkes gives 9·176 cubic feet as the value of c, which would evidently increase the difference between the calculated and the observed pressure of the steam-cushion.

The volume of steam of 7 lb. pressure in the cylinder just before opening the equilibrium valve is 376·831 cubic feet, and the volume occupied by the same steam when the piston had described one fourth of its stroke, and the admission valve was quite shut, was 117·036 cub. ft., so that the relative volume of the steam was then $3377 \times \frac{117·036}{376·831} = 1049$, and its elasticity 21·87 lb. per square inch; according to the indicator diagram it was only 20·4 lb.

We have no means of testing the correctness of the pressures marked by the indicator during the period when the admission valve was open, but the above calculation suffices to prove that the diagram is far from furnishing an exact measure of the steam's elastic force at least in the instance quoted, and that if the whole, or nearly the whole, of the water expended passed through the engine in the form of steam, it was sufficient to produce, by its simple elastic force, a dynamic effect equal to the work actually performed, particularly if the volume of the steam-cushion was only 9·176 cubic feet as stated by Mr. Parkes, and which accords with Mr. Henwood's datum of the volume of steam used per stroke.

Mr. Parkes has rendered some part of his paper rather difficult to understand by an ambiguity of expression relating to the expansion of the steam, accompanied in one place by an apparent contradiction in the facts. He says (page 264), "it is evident that the effect of a given weight of water as steam, consumed during a stroke, will be the same, whether that steam be regarded as having been all enclosed between the piston and cylinder cover, before the piston were permitted to move, when it would expand nearly uniformly from the beginning to the end of the stroke; or, whether it be considered as having been admitted during a portion of the stroke, at some pressure greater than the resistance, and then expanded through the remainder of the stroke."

What the author meant by this we cannot guess; taken literally, it is obviously false, and that it was not intended to be understood so, appears by the calculation of the effective power in the sequel. He continues:

"But, the value of expansion consists, virtually, in the quantity of action derived from the steam, after *it forms an equilibrium with the resistance*.....By tracing it, first, through the space of the cylinder, where *it would barely balance the resistance*; and secondly, through the space during which *it suffered expansion below that pressure*, a true measure of the respective and total quantities of action developed by it, expansively and unexpansively, will be obtained."

The expressions in italics imply that the expansive is separated from the unexpansive part of the stroke at the point where the pressure of the steam is equal to that of the resistance; but the numbers quoted in the next page prove that such was not the author's meaning, for he says, "when the piston of the Huel Towan engine had passed through 50·7 out of 120 inches, which was its total length of stroke, the steam's elastic force and the resistance counterpoised each other." Now we are informed that the resistance was 18·01 lb. on the square inch, and the indicator diagram shows a pressure between 13 and 14 lb. at the point mentioned; but in the diagram of the steam's action at page 294, a pressure of 18 lb. is marked at that point, and the steam and resistance are said to be in equilibrio. We are unable to account for this discrepancy.

A series of well-conducted experiments with Cornish single-acting engines would not only be very interesting with regard to the working of these engines, concerning which so much doubt is still entertained, but would doubtless throw a great deal of light on the general theory of the steam-engine, since they afford facilities for making observations which double-acting engines do not admit of.

A New Line of Atlantic Steamers.—The *St. John's N. B., Herald* informs us that the English Government is about contracting for an additional line of steamers to the North American colonies, which will give a weekly communication with England. The new line will be likely to run direct to St. John's, such being Sir William Colebrook's wish, while the present line will continue to run to Halifax. We presume the new line will be extended from St. John's to this port.—*New York Evening Post.*

BRONZE GATES.

Fig. 1.—Elevation of Gate.

Fig. 4.—Section.

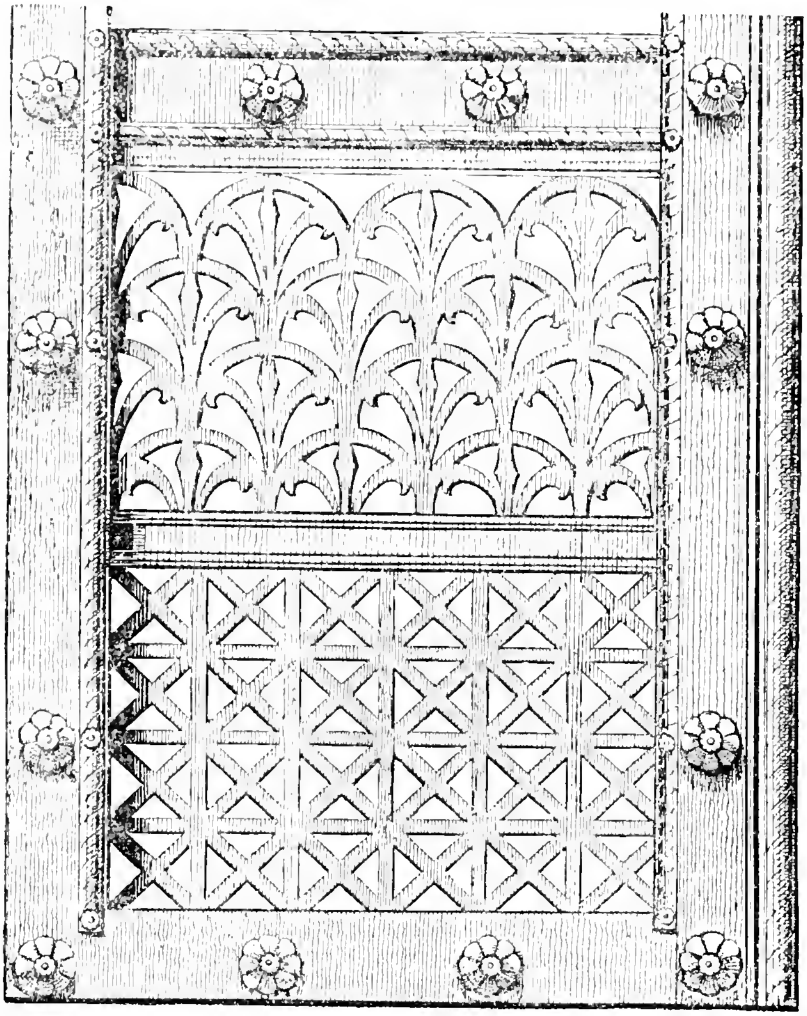


Fig. 3.—Elevation.

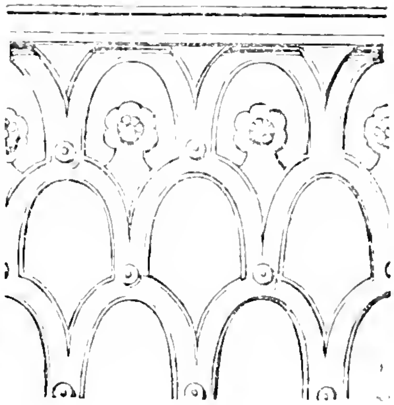
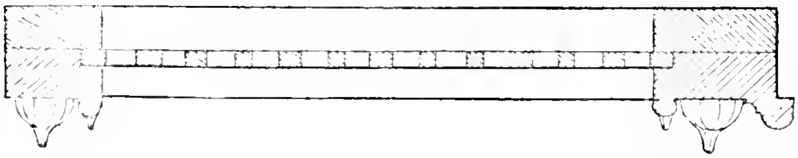


Fig. 5.

Fig. 2.—Plan of Gate.



The "*Revue Générale*" intends to give a series of designs of bronze gates selected from the best examples to be found in France, some of which we propose occasionally to give in the Journal. The annexed engravings represent the celebrated bronze gates of the Cathedral of St. Mark, at Venice.

Fig. 1 is a double panel of one of the gates: two styles and two cross rails, ornamented with projecting nailheads and torus mouldings enclose the principal panel, which is divided into two open compartments by a horizontal rail; the lower part is an exact copy of ancient cross-barred work, and the upper presents an imitation of the *imbrications* often made use of by the ancients; the hollow formed by each of the semicircles is occupied with a kind of fleur-de-lis, such as is generally depicted during the middle ages. The ensemble of this composition is original, and perfectly answers the object proposed.

A horizontal section (fig. 2) shows the arrangement of the different parts of this gate, the thickness of the panels, and the projection of the mouldings and rails which ornament it.

Fig. 3, is a fragment of another panel of the same church, which also exhibits Roman imbrications; in the upper row the artist has introduced some detached flower ornaments, which have a good effect. Fig. 4 is a vertical section of this fragment.

Numerous lion's heads, formerly gilt, are placed in the imbrications which decorate this gate, one is represented in fig. 5. The style of sculpture would serve to point out the age of the gates, were we not aware that they were cast in the 11th century, when St. Mark's was finished.

The annexed designs may be arranged in a variety of ways, so as to form some excellent examples for iron gates, railings, &c., either by repeating the same panel, or taking two panels of one design and one panel of the other, or *vice versa*. Likewise by omitting any part of the ornaments, or all, or introducing others, and the same framework may be applied either vertically or horizontally.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXIX.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. CAMPBELL's Vitruvius Britannicus contains a design for a church, by himself,—"an original invention," as he calls it,—which is nothing more than an Ionic prostyle, pseudo-peripteral along its sides, so far tolerably Grecian as to its plan, but a mere parody of Grecian architecture, as to style. The east end has a large Venetian window, which is the only one in the building, but he says, it would give sufficient light to the whole interior; and if so, it is a pity the hint has never been taken by any one else for structures of that class, instead of cutting up and crowding their designs with a multiplicity of windows, that become so many blemishes, as is the case with St. Martin's Church. In all the various styles of pointed architecture, windows are principal and almost indispensable features, they and doorways being the chief source of decoration, and of character; whereas they are so much at variance with either the Grecian or the Roman style, if intended to be kept up with tolerably consistency, as to be hardly admissible, more especially where the general idea is affected to be borrowed from that of an ancient temple, whither it be a peristylar or merely a prostyle one. Its windows detract very materially from the design of St. Pancras' Church; and when it is viewed obliquely, the flank of the building produces a harsh and disagreeable contrast with the portico—which last is not disfigured, as too frequently happens with any apertures of the kind. That there is authority for windows in ancient structures, is undeniable, because those of St. Pancras are copied from the same edifice as the order itself, and the ornamental details. But then, the application of such features is altogether different from what it is in the original precedent. In the last there are only three at one end of the exterior; in the professed copy there is a range along each side, besides a series of smaller ones below, which gives an air of insignificance to the whole. Were there no other objection against them, it is no small one that they quite contradict the portico, indicating as they do not only that the interior is divided into two floors, but that the ceiling of the lower one or ground floor, is not half so high as the doors! Without entering the church, we may guess that there is in reality no such division, but that the lower windows, are merely intended to admit light beneath the galleries. The question then becomes, what occasion can there be for windows just there, provided the interior be otherwise sufficiently lighted, as it certainly might be? What occasion in fact for side windows at all—unless indeed they can be made to contribute advantageously to external effect—when they might be dispensed with altogether, and a building of the kind—a single spacious room—be lighted entirely from the ceiling, in almost any way that would best suit the particular design?—If, for instance, there is a dome, let the light proceed chiefly, if not exclusively, from that part of the ceiling plan, instead of the concave of the dome being in comparative gloom and darkness, as is the case at St. Paul's. One advantage attending the exclusion of side windows—which except in the Gothic style are more injurious than conducive to effect—would be that the walls being solid, noise from the street would be obstructed. Whether smart Sunday bonnets in the seats under the galleries would be seen to so much advantage as at present, is a different consideration—doubtless a most important one in itself. The galleries themselves are a nuisance; and never have I met with an architect who did not cordially agree with me on that point. The pew-system is not much better, though mightily in favour with

"A loyal Church, that keeps the rich and poor
Duly apart, nor blends the lord and boor.
'Tis sweet to witness *pews*, nor mean, nor scant,
For those who pay,—*free seats* for those who can't," &c.

These lines are from a clever poem which has just issued from Albemarle-street—hitherto considered the seat of High-Church orthodoxy, and conservatism!

II. In regard to the church I have just been speaking of (St. Pancras,) I cannot help thinking that the design would have been very materially improved, had the two caryatic wings, been placed at the west instead of the east end; so as to combine with the portico, and form an extended façade. A very striking composition might have been so produced, one no less distinguished by picturesque variety than by its richness. Those wings would have balanced the tower above, and given a pyramidical outline to the whole structure as viewed in front. Neither would it have been the least recommendation of such arrangement, that the wings would have served to screen the insipid side elevations. It would however have been further desirable that instead of being merely stuck on to the body of the edifice, as at present, they should be made to unite with it symmetrically, for at present the upper line of the cornice ranges with no other line, but falls about midway of the windows.

III. Caryatides or *anthropostyle* supports to an entablature, as they may very properly be described, entirely upset the *old-women* critics' fudge as to the different orders being proportioned after the human figure, their proportions being more robust than those of the "manly Doric." Whether these columnar ladies were matrons or virgins, is a point I leave to be settled by the more curious,—and indeed, I almost wonder that no one should as yet have given us some learned twaddle in regard to it;—but it is certain that they are by no means of that maypole appearance which those dames must have exhibited, who stood for models of Ionic and Corinthian columns. After all it is possible that the Greeks borrowed the idea of Caryatides from Holland, for they are most indisputably very Dutch built, and to all appearance brawny enough to perform the office put upon them, without flinching.

IV. If for no better one, it is for this last reason that I do not object to the use of Caryatides, as being disagreeable to the feelings. Thank heaven! my feelings are not quite so refined and super-refined as to be shocked at beholding ladies of stone, bearing a burden they seem quite able to support. I should as soon think of expressing my sympathy for the Cardinal Virtues which are frequently turned out of doors, and doomed to keep watch on the outside of a building in all weathers, while the Cardinal Vices, perhaps, are enjoying themselves very snugly within.—As soon should I think of being mawkishy sentimental, and compassionating some poor devil of a Neptune who is compelled to stand as a sentinel on such a ticklish situation as the top of a pediment, to be there roasted in a broiling sun. It is wonderful how vastly sentimental many people can be, provided the display of outrageously fine feelings costs them nothing! Many a one who would almost pretend to snivel at "Patience on a monument smiling at grief," would drive over a poor old apple-woman and her stall, as unconcernedly as if she were a mere stock and stone. And yet the Apple-woman is a more perfect image of patience, than all the "Patiences" ever sculptured, were there one upon every hypocritical monument that has been erected.

V. Panegyric, as Swift observes, "is all pork, with very little variety of sauce: for there is no inventing terms of art, beyond our ideas; and when our ideas are exhausted, terms of art must be so too." This last remark certainly holds good, in regard to those writers and critics who repeat what they have picked up in praise of Palladio and Jones, pretty much as a parrot would repeat a pater-noster. They would fain insist upon our believing that those worthies possessed every architectural virtue and excellence; but to dwell upon their merits, or to examine the beauties of their edifices one by one, assigning to each its due value, is more than they care to attempt,—for reasons perhaps, well known to themselves, and not difficult to be divined by those who are not arrant gulls. Very quickly indeed are their ideas of art exhausted, for after they have uttered some stale commonplace, or vapid truism they are completely aground. It may be questioned whether "the celebrated Inigo Jones" would consider Goldicutt's publication of Heriot's Hospital, particularly complimentary, since the account of it is dispatched in less than a page and a half, without any thing being said in regard to the structure itself. Yet its beauties certainly require to be carefully pointed out, for they are of a kind quite invisible to unprejudiced eyes. Not so, however, the defects, they being glaring enough. The entrance tower might be supposed to have been intended as a whimsical burlesque on modern applications of the ancient orders; and the whole is no better than an architectural hotchpotch—an unintelligible, Babel-like jargon of styles jumbled up together. Still, for aught I can tell, the Doric entrance and Corinthian patchwork above it, may be precisely that part of the design which finds most admirers. The great charm after all, I suspect, lies in the name of Inigo Jones: take away that, and few persons would be able to discern any beauty or grandeur in it whatever.

VI. In the "Magasin Pittoresque" it is said that the windmill, built by him at Chesterton in Warwickshire, does Jones no less honour than the palace of *Blenheim*"! It is a wonder the writer did not favour us with the information that Inigo Jones was the father of the equally "celebrated" Tom Jones, of whom there is a tolerably well written life by one Mr. Henry Fielding, an author not very much inferior to some of the second-rate geniusses of our own enlightened age.

HISTORY OF DECORATIVE SCULPTURE IN FRANCE.

By ALBERT LENOIR, Architect.

(Translated for the Civil Engineer and Architect's Journal, from the Revue Générale de l'Architecture.)

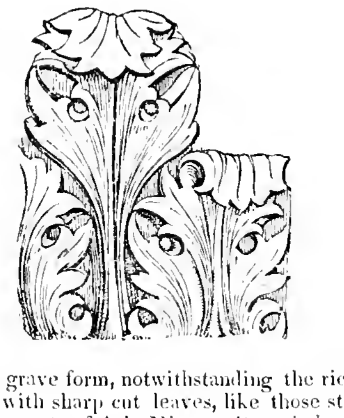
GAULISH PERIOD.

In the earliest ages men, in however rude a condition, have always been fond of decorating their dwellings, an impulse to which the Celts and the Gauls gave way, and of which we find many evidences in their monuments. On the coasts of Britany, and on the sides of Druidic monuments, we see rude sculptures of rays and spirals so combined as to produce something of a decoration. On the well known peulvan or rough obelisk of Kervéaton in Finisterre, we find the head of a bull represented in such a way as to enable us to comprehend the outline. All other monuments which preceded the civilization of Gaul by the Greeks and Romans, except those of the Druids, having perished, we are deprived of the opportunity of describing the mode of ornamentation adopted by the Aborigines.

GREEK PERIOD.

The Phoceans, as is shown by the remains preserved in the Museum of Marseilles, brought into Gaul the elements of Asiatic art, which they used with taste. In 1773 M. Grosson, an inhabitant of that city, published a quarto volume,* in which are engravings of many ancient monuments, found within the boundaries of the old colony. Notwithstanding the mediocrity of the representations, we can easily recognize on some of the tombs, decorated with bas reliefs and inscriptions, how completely they had succeeded in imparting a classic taste, the crowns of olive leaves, and wreaths of flowers and foliage boast the same elegance as on the coasts of Attica or the Peloponnesus, Caria or Ionia. On the borders of the territory of the Greek colony, in a place called Le Bas Vernègues, near the Pont Royal, on the road from Aix to Lambesc, is to be seen a temple of the Corinthian order, evidently of a Greek character, both as regards its general composition and the style of its mouldings and ornaments, as may be judged by the following engraving.

Fig. 1—Leaves of the capital of Vernègues.



The capital of a grave form, notwithstanding the richness of its details, is decorated with sharp cut leaves, like those still to be seen at Athens, and on the coasts of Asia Minor. It reminds us of the foliage used in the decoration of the capitals of Pompeia, sculptured in the Hellenic school. In the temple of Vernègues, the bases of the columns, the mouldings of the pedestal, and the proportions of the architraves have evidently been designed and executed by Greeks.

The influence of the Asiatic colony was not limited to the bounds of the Marseillese territory, but was felt throughout Gaul, and thus it is we find at Vienne in Dauphiny, and at St. Remy-en-Provence, the ancient Glanum, traces of oriental art, as readily to be recognized there as in the fragments of the Phocean metropolis.

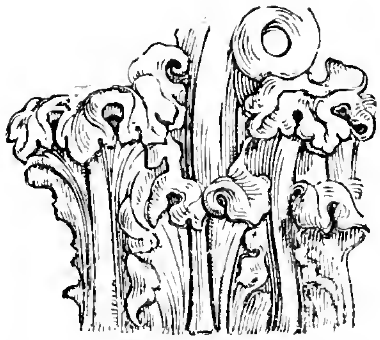
When Gaul came under the power of the Romans the Greek spirit still survived, as we may see in the case of the two cities just mentioned. At Vienne, the capitals of the temple of Augustus and Livia, were executed on the Greek plan, as may be ascertained by the finely executed sharp leaves, and in the Museum of Vienne, formed in the cella of the temple may be recognized more than one fragment which shows the Greek chisel.†

* Recueil des Antiquités et Monumens Marseillais, 1 vol. 4to., Marseille, 1773.

† The reader may consult *Antiquites de Vienne*. 1 vol. in folio, by M. Reg, Director of the Museum of Vienne.

The tomb of St. Remy, raised for a Roman personage, as the inscription, figures and bas relief show, was also of Greek workmanship, this we can trace in the fragment of a capital represented in the following engraving, and further proved by the Greek contour of the mouldings.

Fig. 2—Leaves of the capital of St. Remy.



The capitals surmount the columns, decorating the upper part of the tomb; the sculpture of them is broad and well massed.

The triumphal arch at Orange is a monument cotemporary with the first victories of the Romans in southern Gaul, in it we trace something Greek, every detail serving to remind us, in some degree, of that school. The composition of the mouldings of the entablature, and particularly those at the top of the architrave bring to mind the profiles seen in the ancient edifices of Asia Minor; a cavetto is seen surmounting a line of ova, reposing on a string of pearls, a detail completely Ionian.* The modillions, decorating the principal cornice of the arch, have a remarkable peculiarity which is met with in the octagonal monument at Athens called the Tower of the Winds, and as we shall hereafter see reproduced in the Maison Carrée at Nimes, an edifice of a later date than that on which we are now treating. These modillions are sculptured in an inverse way from those which decorate all the ancient entablatures, the larger part, instead of resting against the cornice so as to form a console, is on the contrary near the outer edge of the corona, a very rational arrangement by the bye if we consider this part of the decoration as being derived from a wood building, and as the expression of the pendent extremities of the rafters, supporting the tiles. The resemblance between this entablature at Orange, and the Athenian edifice, which as it is described by Vitruvius,† must be of ancient date, comes in confirmation of the influence exercised by Greece on architecture and its details in southern Gaul. A specimen of the Greek palmetto is to be found in the midst of the foliage of the upper ogee of the impost of the Arch at Orange. The coffres, decorating the arches are executed with more delicacy than in any Italian monuments, particularly in the double arches, where we observe a happy arrangement which adds to the finish of the execution. In general, the Roman monuments of southern France show in their ornamentation a lightness of touch which may be attributed to the Greek school as introduced by the Phocean colony.

We have already shown what Hellenic elements are observable in the tomb of St. Remy: the same we have to notice in the triumphal arch of that town, particularly in the double arches decorated with arabesques. The archivolts of this monument, as well as those of the triumphal arch of Orange, are decorated with foliage and fruits, taken from the produce of the country, an interesting ornament as it makes us acquainted with the state of culture at that date.‡

ROMAN PERIOD.

Out of Provence we perceive a considerable change in the style of ancient architecture, approaching to the Roman forms, of which Nimes, one of the richest cities of Europe in antiquities, affords many examples, having been for a long time opulent enough to construct fine buildings. Augustus gave walls to Nimes, as is attested by an inscription on the gate, still bearing his name. The Corinthian capitals of the pilasters of this gate are executed with breadth, and remind us of the style at that period adopted at Rome. To the same emperor is attributed a portico which decorated the fountain of the Baths, the fragments of which are preserved on the site of the Temple of Diana. In the Maison Carrée are two of the finest bases ever sculptured by

* See the works of M. Choiseul Gouffier and of the Dilettanti Society of London.

† Vitruvius, book 1, chapter 6.

‡ See the introductory plates to the History of France, by Jorand, Jouffray and E. Brecon.

the ancients, also parts of the fountain.* At the temple of Diana are to be seen many fragments of richly ornamented double mouldings, which decorated the lower part of the great pedestal or stylobate in the centre of the Baths. They are beautifully executed. Neither must we omit the long marble frieze of the stylobate of the fountain preserved in the Maison Carrée.

The temple of Nimes, known by the vulgar name of the Maison Carrée, and built in honour of the grandsons of Augustus, was executed by skilful artists; the capitals, in the Roman manner are broadly modelled, but we can see here, as well as on the frieze, abundant proofs of a difference in the skill of the several workmen employed. The modillions of this temple, as we have already mentioned, exhibit the same peculiarity as those on the Triumphal Arch at Orange, but being deeper cut, they are evidently imitations. The great gallery or colonnade around the temple, forming the sacred boundary, shows the same style of sculpture as the temple itself, but with less luxuriancy in the details: the frieze was formed of garlands, fruits and flowers, bound with floating ribands.

Antoninus, who was a native of Nimes, adorned that city with many important buildings. To him are attributed a temple and a basilica dedicated to Plautina; and the fragments of sculpture collected in the Museum, apparently belonging to this golden age of art, fully bear out their claims. Among these may be remarked the eagles supporting the olive garlands; and a frieze composed of ox sculls, supporting garlands of fruit.

Vienne, the rich Museum of which is formed in the temple of Augustus and Livia, possesses more than one fragment of the best ages of Roman art.† Here are to be seen the cornice, frieze and architrave of a beautiful entablature, on the frieze of which is particularly to be remarked the rosette which serves to unite the bends of the foliage. The cornice is less remarkable, showing as it does in its modillions evident symptoms of the decline of the arts, first, because their form is that of a console en talon, little in harmony with the richness of the other members; second, because these modillions are all decorated differently, which is contrary to the strict rules of the best periods of art. It is singular that among all the remains of ancient art those of France alone should be found to present these departures from the general rule, an exception which we shall have occasion to remark both during the history of the Roman period, and of the middle ages, in which this variety of form became the parent of riches to a new style. In the Museum is also to be seen a beautiful piece of monumental sculpture, forming a frieze, and consisting principally of an eagle attacking a serpent. It seems to belong to the time of Septimus Severus.

Arles, a city of little importance before the time of Constantine, rapidly increased under the reign of that prince, and became to a certain extent, the Gallic Rome. Extensive buildings, still in existence, serve to show its splendour, but art was no longer what it was under the Antonines, the theatre, capitol, amphitheatre, and great cemetery or elyseum, show by the bad taste of their details, and the transposition of the principal members of the styles, how complete was the decadence. The capitol, of which a part is still to be seen in the Men's Square, consists of a ruin composed of two columns, crowned with an entablature and the fragment of a pediment; the ornamental sculpture is neglected, the frieze being composed of scrolls without character, while in the capitals, the bad proportions of the leaves indicate the period of ignorance at which the monument was erected. The theatre exhibits greater signs of decadence than even the capitol, the entablature of the lower story presenting the greatest anomalies, the sculptors have placed a frieze decorated with triglyphs and rosettes immediately above the capitals, where the architrave ought to be; then come a frieze in bad taste, and a badly proportioned cornice. In the Museum at Arles is preserved part of a marble entablature, which appears also to belong to the time of Constantine; the modillions varying every two and two in their decoration, which we have already pointed out as contrary to the principles of classic antiquity.

The walls of the city of Sens, of which the destruction, going on even now, presents numerous details of ancient architecture, placed by the Romans themselves on hasty foundations made in the time of the Emperor Julian, have afforded several cases analogous to those we have mentioned under the head of Arles.

The city of Autun, celebrated in Gaulish history and the capital of a province, has preserved some remarkable monuments. Those in the best condition are two gates attributed to Constantine, who was a great patron of the town. These two military constructions are in good style, both as regards the architecture and the ornamental sculpture, notwithstanding the well known general decadence of art which prevailed under the first Christian emperor. In the same city an ancient entablature of the Gallo-Roman epoch, which affords an example unique in France, of modillions sculptured on the angle of the corona. The ornamental details of this fragment show one of the last periods of Roman art in Gaul; we can however recognize the fertile imagination of the native artists, in the variety of *motifs* in the sculpture, which change the form and character of each modillion.

A triumphal arch of large proportions is formed in the walls of the city of Rheims, and is now known as the Gate of Mars. The construction has been attributed to Cesar by some modern writers, although there is nothing to give any foundation to this notion. An examination of the sculptural details of this edifice is enough to prevent its being assigned to any period anterior to the Lower Empire, and perhaps it ought rightly to be placed in the time of the emperor Julian, who fought often enough in the East of Gaul to obtain triumphal honours in a provincial city. In this monument the sculpture is of most uncommon barbarism, the foliage being scarcely of a recognizable form; the capitals out of proportion surmount heavy and badly chiselled columns, and the mouldings of disagreeable figure are made heavier by ornaments of which the model is a large hole in the midst of a shapeless leaf.

* Antiquites de Nimes, by Clerisseau.
† Antiquites de Vienne, by Rey.

HISTORICAL SKETCH ON THE USE OF BRONZE IN WORKS OF ART.

By Cesar Daly, Architect.

(Translated for the Civil Engineer and Architect's Journal, from the Revue Generale de l'Architecture.)

(Continued from page 219.)

The exertions of the Italian artists excited general emulation throughout Europe; and in a very short time every country used bronze for the decoration of its public edifices, and to transmit to posterity the deeds of its kings and great captains. Italy erected statues to the Medici and the Farnese, Spain to Philip III, Russia to Peter the Great, Sweden to Gustavus Adolphus, and England to Charles Ist. Much might be said with regard to the progress of this art, but we consider ourselves obliged on account of the extent of the subject to limit it to the history of bronze in France.

It was under Louis 14th, that this art made rapid progress through the enlightened endeavours of the two brothers Keller, whose principal master pieces are yet to be seen adorning the royal palaces of Versailles and the Tuileries. In 1699, Balthazar Keller cast in one piece the equestrian statue of Louis 14th, modeled by Girardon. This colossal mass was more than seven yards high, and yet weighed only 26,072 kil. (57,50 lb.) It seemed however as if the art of founding had only attained this state of perfection soon to fall into decadence; the equestrian statue of Louis 15th, cast by Gor in one piece, from the model of Bouchardon, and afterwards raised on the Place de la Concorde, was only 5·40 m. (17 ft. 9 in.) in height, while its weight was 29,370 kil. (64,775 lb.) During the revolutionary crisis, the only bronze work was limited to cannon; but under the Empire, bronze was again appealed to, to take its place among the other arts in representing the military triumphs of the French. Unfortunately the art had been too long neglected to allow of success, and some of the first essays were not prosperous, the statue of Desaix was a complete failure, and the Column of the Place Vendôme is far from being a master-piece of founding.

According to M. Payen, to whom we are indebted for the following details, the execution of the Desaix statue was put up to contract, and it was undertaken for 100,000f. (£4,000), a price in which the bronze was not included. The contractor gave up his bargain to a bell-founder, and he knowing nothing of the fashioning of such great works, and calculating upon the basis of his ordinary limited operations, engaged to do it for 20,000f. (£800); but in order to economize as much as possible, he required that the sculptor should be forbidden from superintending the moulding. The most difficult hollows were filled up, in order to avoid the trouble they would occasion; an attempt was made to mould in sand with frames, furnaces were erected, and an ill-constructed scaffolding, and after many useless arrangements and expenses, the bronze was let out, and having burst the moulds, ran about. Thus the operation completely failed, a good deal of the bronze was lost, and it was necessary to begin again. The founder then tried to cast the monument in pieces, but not arranging his moulds well, nor securing a uniform mixture of the metal, the pieces produced were dissimilar. He managed however to fit them together, but all the proportions of the figure were altered, and as these defects could not be remedied by the chisel, a most wretched monument was produced.

When the Column in the Place Vendôme was erected, the same faults were repeated; a bargain was made with an ironfounder, who had never been engaged in bronze work, he however had the temerity to undertake the moulding and finishing at one franc per kilo. (9*d.* per 2 lb.) The government on the other side undertook to deliver to him in guns, taken from the Russians and Austrians during the campaign of 1805, the quantity of bronze necessary for the completion of this enormous monument. The founder used a furnace he had for casting iron, but not being aware of the phenomena of bronze casting, and urged by his vanity to attempt in the first instance the casting of several of the great pieces of the base of the column, he encountered several defeats. Each time he necessarily altered the alloy by oxidizing the tin, lead and zinc, which metals so oxidized passed into the scoriæ or were carried off by the current of warm air. He did not perceive this cause of continual loss, and continued to produce the bas reliefs; but it may be readily conceived that they contained more copper than the bronze of the guns. When the founder had got two thirds through the column, he found out that he had got no more metal, and being, according to contract, responsible for the metal delivered to him, he was at once ruined. In this lamentable situation he tried to melt up the white metal obtained from the reduction of the scoriæ, and a large quantity of refuse metal which he had bought up at a low price. The bas reliefs which he obtained from the mixture of all these materials were marked with blotches and lead spots, their colour from a dirty grey became quite black; the authorities refused to receive work so defective, and put his foundry under sequestration. He succeeded, after much petitioning, in obtaining a committee to examine his accounts, which was composed of two chemists, two architects, two mechanical engineers, and two founders, with an auditor of the Council of State for the chairman. The weight of each piece delivered by the founder was known; specimens were taken from them, and the proportional parts weighed, from which was made an ingot representing the mean composition of the whole column. It was then found by analysis that it contained:

Copper	89·440
Tin	7·200
Lead	3·343
Silver, zinc, iron	0·017
	100

The committee then took specimens of bronze from the guns remaining in the government stores, and an ingot was formed to represent as nearly as possible the mean composition. The analysis of this ingot gave the following proportions:

Copper	89·360
Tin	10·040
Lead	0·102
Silver, zinc, iron, loss	0·498
	100

It was further known, that the law in France had fixed the composition of gun metal at 90 parts of copper and 10 of tin per cwt., but that this law was never well executed, and during the revolution scarcely attended to at all; it was also known that these foreign guns were of a more complicated and baser alloy than the French. Taking all these circumstances into consideration the committee were of opinion that the founder had produced an alloy, if not superior, at least equal, to that which had been given to him; and that they considered that he could not be charged with fraud in his contract. The chemical operations further explained the whole proceeding: by making separate analyses of the specimens of the great bas reliefs, the shaft, and the capital, it was found that the first had only 0·06 alloy per quintal; the second, particularly towards the upper part, and the third contained as much as 0·21. It was therefore evident that the founder not knowing how to manage bronze, had refined his alloy by several times remelting, and consequently diminished the total weight, and that to make up for this loss, he was obliged to put into the last castings the white metal extracted from the scoriæ. Thus he had given bronze of too good alloy in the beginning, which had obliged him at last to make the alloy too low. The moulding of the several bas reliefs was so badly executed, that the chaser employed to go over them, removed by chiseling or filing, a weight of bronze equal to 70,000 kils. (7 tons), which were given to him, besides a sum of 300,000f. (£12,000) paid down.

It was certainly hard to pay so dearly for experience, but fortunately it was profitable; not however that all the subsequent bronze works in France have been more successful, for the founders had to submit to several severe checks, and were obliged to study the processes, and proportions necessary to form a good alloy. Thus when in 1817 Lemot was employed to cast the equestrian statue of Henry 4th, now on the Pont Neuf, he at least took the precaution to take specimens from three bronze statues of Keller at Versailles, which were the best, with regard to casting, green colour, and the grain. The following is the result of his analysis.

	No. 1.	2.	3.	Mean.
Copper	91·3	91·68	91·22	91·4
Tin	1·	2·32	1·78	1·7
Zinc	6·09	4·93	5·57	5·53
Lead	1·61	1·07	1·43	1·37
	100·	100·	100·	100·

Lemot thought that he had gained experience enough from these analyses, but he did not escape from serious difficulties during the casting. Wishing to make use of the furnace, which had been built for casting the equestrian statue of Louis 15th, formerly in the Place de la Concorde, but the furnace not having sufficient draught for the fusion of Keller's alloy, in which there was more copper than in that of the statue of Louis 15th, he was obliged after several trials to make great changes, and still the casting did not perfectly succeed. The body of the king had several hollows in it, and the belly of the horse failed, a hole so large having been formed that it was obliged to be filled up; further 14,000 kilo. (14 tons) of oxidized rubbish was sold off.

Casting in bronze, although presenting only slight difficulties in the manufacture of objects of small dimensions, has always required greater responsibility when it is required to form considerable masses, perfectly homogeneous. The component metals are deficient in energetic affinity for each other, when in fusion tend to separate in the order of their densities, and, when the less fusible begin to solidify, the others in a liquid state, rise up towards the top, where the easy oxidation of a component part of the alloy always causes the risk of refining the metal. Besides these great obstacles, others are encountered in calculating the several component parts of the bronze, where it is wished to obtain precisely the required quantity of metal for the object to be cast, also in the preparation of the model, the construction of the furnace, and the disposition of the moulds. These and other difficulties explain how many abortive attempts sometimes preceded in former days the casting of a large work in bronze. They point out why Falconnet was 15 years casting the equestrian statue of Peter the Great, which figures on an immense monolithic pedestal at St. Petersburg; why the Kellers were 9 years casting the statue of Louis 14th; why Bouchardon and his successor Pigalle took 8 years for that of Louis 15th, on the Place de la Concorde; why the statue of Desaix, and we may almost say the Column of the Place Vendôme, failed, and why the great equestrian statues we have mentioned did not come perfect out of their moulds. The statue of Peter the Great was obliged to be begun again from the knees of the Czar and the breast of the horse, to the top of the statue. Bouchardon had much trouble in restoring the delicate forms of the horse in his beautiful equestrian statue of Louis 15th, which were badly produced in the lower part, and we have related the difficulties encountered by Lemot and Piggiani in casting the statue of Henry the 4th, difficulties which lasted four years. We cannot better finish this essay than by mentioning those which have just been surmounted in casting the various parts of the July Column, and for the better effecting this we shall compare it with the Column of the Place Vendôme, which is the only one having any analogy to it. The Vendôme Column is only coated with bronze, and the largest pieces are only five yards in extent, while each of its tambours is composed of six pieces, and the whole cost of the column in specie and metal provided by the state was 2 millions (£80,000). The July column on the other hand is entirely of bronze, and each tambour is in one piece, the base of the column extends about 16 yards, and the capital at the most extended place has the enormous dimension of 26 metres, 85 feet. This column however only cost 1,172,000 francs (£46,880).

Inequalities in the thickness of the parts constitute one of the great difficulties of casting, because the thin parts cooling rapidly, and the thick parts slowly, the shrinking of the former taking place sooner than that of the latter is apt to split the metal. It may be also conceived that the shrinking of a large object is so much more than that of a small one, as its dimensions are greater, and the necessity for taking this into consideration causes a fresh difficulty in the construction of the mould, which must be calculated so as to provide for the contingency. It is easy in the same way to conceive that the least motion of the mould, during the operation, will cause the required thickness to be exceeded. These considerations will explain the difficulties which had to be surmounted in casting the several parts of the Column of July, and as to the statue we cannot do better than republish an extract from the report of M. Hericarb de Thury, made to the *Société d'Encouragement*, on the improvements introduced by M. Soyez in the moulding of bronze sculptures.

"This statue 4·25 m. (14 feet) in height, supported on the toe, and bending forward, presented great difficulties in the moulding, and still greater in the casting, as the solidity of the statue depended on the extreme lightness of the upper parts, and the strength of the leg on which it is supported. Had the old methods been resorted to, the figure would most probably have failed, or have been tried in several pieces; because the upper part being very thin would cool down immediately, while the lower part cooling more slowly, would have contracted on itself, leaving at the ancles an opening of about 25 millimetres (an inch), the metal contracting from 12 to 14 millimetres per metre (½ an inch) and the statue would undoubtedly have been lost. To obviate these difficulties, M. Soyez determined upon casting it head downwards, by which he diminished the danger, I say diminished, for in this posture, the mould must have yielded, or the leg broken above the ancle. To provide for this, M. Soyez placed on each side of the foot a branch of copper 6·6 met. (26 in.) broad, finishing in a strong head, so as to force the foot to contract on the knee. Further these branches were so managed as to be rather thinner than the leg. Full success crowned the trial of this bold and ingenious innovation, the casting of this admirable statue succeeded in every detail, being perhaps the first time that a figure of this importance was cast without any defect. The thickness of the statue is from 4 to 5 millimetres (a sixth to a fifth of an inch) in the upper part, except the wings, which are only 2 millimetres. The supporting leg is 55 millimetres (2¼ inches) thick, beginning from the ancle, and progressively diminishes in thickness up to the thigh."

The monument of July undoubtedly marks a new era in the history of the art of bronze casting, and places France in the first rank in its pursuit, and in order to do justice to M. Soyez, we must mention some of the improvements effected by him. This artist has got rid of the use of iron as a means of consolidating isolated parts of figures, and particularly in supporting members; he casts these parts full by turning the figure upside down, which is an important innovation. He gets over the resistance of the sand of the mould on the contraction of the metal, not only by the weight of the mould, but by the progressive tenacity of the bronze while cooling. This tenacity, which may be considered as proportional to the area of the section of the part so cast, is increased at pleasure by accessary parts placed in the mould according as they are wanted. It is thus that the Genius of Liberty was cast, having as it were a second shapeless leg placed parallel to that which supports the figure, and intended to become at the period of contraction, auxiliary to the statuary leg to which it was united by the two extremities. Thus also was cast the bent back leg of the horse of Charles Emmanuel of Savoy. In order to prevent this leg from breaking in the ham when cooling, the foot was united to the thigh by a strong tenon, which was afterwards chiselled away.

ENGINEERING WORKS OF THE ANCIENTS, No. 7.

WORKS OF HERCULES.

Besides the performance of the Egyptian Hercules already mentioned, Diodorus Siculus, Book 4th, gives an account of several works of the Greek Hercules. Not to speak of the operations attributed to him at the Straits of Gibraltar, there were two hydraulic works in Greece said to have been executed by him. The large champain country about Tempe being all over a stagnant lake, he cut trenches through the lower grounds, and through these trenches drained all the water out of the lake, by which means were reclaimed all the pleasant fields of Thessaly as far as the River Peneus. In Beotia he did quite the contrary, for to punish the Minyœ it is related that he caused a river to overflow the whole country, and turn it into a standing pool. In his passage of the Alps from Gaul, an expedition in which he was the predecessor of Hannibal and Napoleon, he levelled and opened the rough and difficult ways to make way for his army and carriages. In Italy Hercules performed some remarkable works about the Lake Avernus, for whereas the lake extended as far as the sea, Hercules is said by casting up earth, to have stopped up its current, and to have made the way near the sea, called the Herculean way.—In Sicily to express his good wishes for the inhabitants, he caused a pond or tank to be sunk near the city of the Agrineans, four furlongs in compass, which he called after his own name.—In Greece Hercules had the further merit of having diverted the River Achelous into another channel which he had dug for it. This irrigated a considerable part of the country, and was done to please the Calydonians. It gave rise to the poetical fable that Hercules fought with Achelous transformed into the shape of a bull, and in the conflict cut off one of his horns and gave it to the Etolians. This they call Amalthea's horn, in which the poets feign that there grows all manner of summer fruit, as grapes, apples, and such like, not the only time by the bye that engineers have filled the horn of plenty.

DEDALUS—ENGINEERING FESTIVALS.

Diodorus gives a long account of Dedalus, from which we have made the following extracts. Dedalus was an Athenian of the family of the Erechthidæ, being the son of Hymetion, son of Eupalamus, son of Erechtheus, King of Athens. He was extraordinarily ingenious, and very studious in the art of architecture, an excellent statuary and engraver upon stone, and improved those arts with many notable inventions. Dedalus was obliged to flee to Crete for the murder of his nephew Talus, who was killed by him out of envy. To Dedalus is attributed the invention of sails for ships. After leaving Crete he staid with Cocalus and the Sicilians, in whose country Diodorus, a native, says that works of his were to be seen in that day.

While on the subject of Dedalus we must not omit what the Biographie Universelle says on the subject of festivals established in his honour. When the Plateans returned to their native city, 311 B.C., after an exile of sixty years, they instituted an annual festival called Dedalia, which every sixtieth year was celebrated with extraordinary magnificence. All the trees cut down were made into statues called Dædala. The name of Dedalia was also given to a Theban fete in honour of the reconciliation effected between Jupiter and Juno by Cithero.

TALUS.

Talus is sometimes called Atalus, Calus, and Acalus; he was the nephew of Dedalus, as before mentioned, and murdered by him. Being the son of Dedalus's sister, and but a young boy, he was bred up with his uncle to learn his trade. Talus for ingenuity exceeded his uncle, and invented the potter's wheel; he got likewise a serpent's jaw bone, and with it sawed a little piece of wood asunder, then in imitation of the tooth in the jaw, he made the like in iron, and so he found out an instrument for sawing the greatest pieces of timber. He invented likewise the turner's lathe and many other tools.

PROMETHEUS—CRETAN HERCULES—VESTA—MINERVA—VULCAN.

Prometheus is according to some the first who stole fire from the gods, and bestowed it upon men (Book 5th), but the truth is he found out the way how to strike fire out of flint or stone. The Idæi Dactyli are also said to have found out the use of fire. They discovered the nature of iron and brass to the inhabitants of the Antisapterians, near the mountain Berecynthus, and taught the manner of working it, and because they were the first discoverers of many things of great use and advantage to mankind, they were adored and worshipped as gods. One of them they say was called Hercules, a person of great renown. After them were nine Curetes who invented swords and helmets.—Vesta invented the building of houses, and upon this account almost every body sets up her statue in their houses, and adores her with divine honours.—Minerva was the introducer of architecture, and also according to our chronicler of the use of garments, so that architecture and tailoring according to him boast one common parent. Vulcan they say found out the working of iron, brass, silver and gold, and all other metals that require forging by fire; and the general use of fire in all other cases was found out by him.

XERXES—AGRIGENTUM—PHEAX—THEMISTOCLES—DIVERSION OF THE NILE.

The Eleventh Book of Diodorus, is on Greek history, he mentions Xerxes throwing a bridge over the Hellespont, and cutting a canal through Mount Athos.

The Agrigentines in Sicily having acquired great spoil by the defeat of the Carthaginians, took the greater part of the prisoners into the public service, and employed them in cutting and hewing stone. They not only set them to build the largest of the temples, but made water courses and sewers underground, so great and wide, that though the work itself was contemptible, yet when done and seen was worthy of admiration. The overseer and master of the work was one Pheax, an excellent artificer, from whom these conduits were called Pheaces. The Agrigentines likewise formed a tank for fish, at great cost and expense, seven furlongs in compass, and twenty cubits deep. This by neglect of succeeding ages, filled up with mud, and at last through length of time turned wholly into dry ground; but the soil being very fat and rich, it was planted, and yielded the city a large revenue.

Themistocles has the merit of projecting and carrying into effect the construction of a haven at the Pyræus, by which the naval power of Athens was greatly increased. The account of his negociations with the assembly of the people is of much interest in an historical sense, but not immediately relating to the end we have in view, we are compelled to omit it.

In the 21st chapter is mentioned the diversion of the Nile during the war between the Persians and Egyptians.

BLOCKING UP OF THE EURIPUS.

In his 13th Book our historian describes the measures taken by the inhabitants of Eubœa on their revolt from the Athenians. This island being separated from the continent only by the narrow strait of the Euripus, they solicited the Beotians to assist them in stopping it up, in order that they might receive assistance against any attacks from the Athenians who were masters of the sea. To this the Beotians agreed, and all the cities set upon the work, and every one strove with diligence to perfect it, all the citizens, foreigners and strangers being set to work. The mole began at Chalcis in Eubœa on one side, and at Aulis in Beotia on the other, that being the narrowest part. In these straits the sea was very boisterous and rough, but after this work much more unquiet and raging, the passage being made so very straight and narrow, that only one ship could pass through. There were forts built on both sides upon the extremities of the moles, and wooden bridges made over the currents for communication.

CARTHAGINIAN ENGINEERING.

Our author gives an account of several sieges by the Carthaginians in Sicily, who appear from his account to have been as skilful as the Greeks in military warfare. At the siege of Himera in Sicily, Hannibal the elder (Book 13th), undermined the walls, supporting them with great pieces of timber, which being set a-fire, a great part of the walls suddenly fell down.

In the 20th Book, in the account of the expedition of Agathocles into Africa, there is a description which mentions, the country as well irrigated and supplied with canals and sluices.

MACEDONIAN GOLD MINES.

Philip, King of Macedon, (Book 16th), having taken Crenidas, and called it Philippi, so improved the gold mines in those parts, which before were but inconsiderable and obscure, that by building of houses for the works he advanced them to bring in a yearly revenue of above a thousand talents.

ALEXANDER THE GREAT.

The siege of Tyre by Alexander the Great, recounted in the 16th Book, required the execution of works on a very great scale. Alexander demolished Old Tyre, as it was then called, and with the stones carried by many thousands of men, raised a mole two hundred feet in breadth across the sea, which by the help of the inhabitants of the neighbouring cities, who were impressed for the purpose, was speedily carried out a considerable way. This mole was afterwards injured by a violent storm, when Alexander caused it to be repaired with trees laden with earth, and so again brought it near the city. By this and many other operations he was able to take the city, after a gallant defence, in which the inhabitants displayed much ability.

In the memorandum books of Alexander examined after his death, (Book 18th), were found heads of six colossal plans, among which were the following,—that a plain and easy road should be made straight along the sea coast of Africa to the Pillars of Hercules, that six magnificent temples should be built, and that arsenals and ports should be made in places convenient for the great navy he contemplated. These things, although highly approved by the Macedonians, yet because they seemed things beyond all measure impracticable, were desired to be laid aside.

INUNDATIONS.

During the Seleucian war, (Book 19th), the Macedonians under Eumenes encamped on the banks of the Tigris, about three hundred furlongs from Babylon, Seleucus occupying the river with a flotilla of small vessels. The Seleucians, having sailed to an old water course, cut down the banks at a part where it had been filled up from length of time, upon this the Macedonian camp was surrounded with water, and all the tract of ground overflowed, so that the army was in great danger of being utterly lost. At last removing a great part of his army in flat bottom boats, he caused all the Macedonians to repass the river, and then for the purpose of recovering his carriages and baggage, by the direction of one of the native inhabitants, he set about cleansing such another like place, by which the water might be easily diverted, and the ground all round about drained dry. When Seleucus perceived this he granted a truce, and the works were suspended.

In the same book is the account of the natural inundation, by which the city of Rhodes was so much injured. Rhodes being built in the form of a theatre, and the rain very heavy, the water ran for the most part into one place, and the lower parts of the city were presently filled with water, for the winter being looked upon as over, no care had been taken to cleanse the channels and sewers, and the pipes likewise in the walls were choked up, so that the water stood several feet deep, until part of the city wall breaking down, the pressure was suddenly relieved.

PILEWORK.

In a mention of the Cimmerian Bosphorus in Book 20th, it is related that the king's palace was surrounded with the river Thasis, and that there was a road to it through the fens, guarded with forts and towers of timber, raised upon pillars over the water.

DEMETRIUS POLIORCETES.

We find in the 20th Book a long account of the siege of Rhodes by the celebrated Demetrius, who among other works made extensive mines under the city walls, which being told to the Rhodians, by a deserter, the Rhodians made a deep trench along the walls, which was now ready to be tumbled down, and forthwith fell to countermining, and at length met the enemy under ground, and so prevented the mine from proceeding any farther.

MR. MUSHET'S PAPERS ON IRON AND STEEL.—No. 3.

Sir—The opinions adopted by Drs. Ure and Karsten respecting the quantity of carbon in iron, namely, assigning to white cast iron a larger proportion than to gray, and taking the manifestation of the graphite fracture in the latter as a certain sign that the quantity of carbon in the metal is on the decrease, appear to me so much at variance with, and subversive of, all that practical men have understood and believed upon this subject, that it is my intention, with your permission, to make a few remarks upon the matter, in order to ascertain, by an examination of facts, how far they are borne out by the appearances which we every day see exhibited on the scale of manufacture, and in the manipulation of the metallurgical department of the laboratory.

I hope your readers will not consider I have travelled out of my way to make any gratuitous observations on Dr. Ure's most elaborate work further than the necessity of the case required, seeing his views of the subject are at direct variance with my table of the proportions of charcoal used in the fusion, and in forming the various qualities of iron and steel so frequently referred to in these letters.

As a prelude to the subject, and with a view to enable your readers to arrive at a more clear understanding of the points at issue, I shall define and class the distinct characteristics which cast iron assumes. Nothing can be more marked in the page of metallurgy than those divisions in the progressive stages of this metal:

1st. Steel-grained cast-iron, or crude steel.
2nd. White cast iron.
3rd. Gray cast iron.

In the absence of chemical analyses, but grounded upon numerous direct and comparative experiments, I have considered steel-grained cast iron to contain from 1 to $1\frac{1}{2}$ per cent., the white cast iron from $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent., and gray cast iron from $2\frac{1}{2}$ to 4, or, when richly carburetted, to $4\frac{1}{2}$ or 5 per cent.

Steel-grained cast iron is rarely to be met with at the blast furnaces in this country: decided traces of it are occasionally to be found in the commencement of a blast, particularly should the furnace be started with too heavy a charge; a high temperature being required to maintain its fluidity, it either sets on the bottom of the furnace, to be cleared off afterwards by an alloy of gray iron, or it escapes with the white iron when the furnace is tapped. At this juncture, which, when steel-grained iron is produced, is always one of difficulty in the affairs of the furnace, should the iron which has been obtained be examined, it will be found possessed of a white fracture, frequently mixed with a portion of the steel-grained iron.

Calcareous ores, however, afford the steel-grained cast iron more as a natural product; the supposed alloy of the metal of lime with the iron produced from those ores, renders the white cast iron more lively and fluid than the gray, and becomes in some measure a substitute for carbon in maintaining a considerable degree of fluidity, when the metal is at any time passing into the steel-grained quality, so as it may be run out of the furnace in quantity, and with a comparatively clean cinder.

Castings made of such iron possess a degree of strength quite unknown in the general operations of the foundry; they will beat up like soft steel, and acquire by hammering a permanent flexure like malleable iron; but, as far as my information and experience go, all attempts hitherto to remelt it have failed.

Rare as this peculiar state of the metal may appear to the iron maker of this country, yet the whole of his metallic produce, in passing through the furnace, must have, in the first instance, been subjected to this process of steelification, before it absorbed enough of carbon to constitute it white cast iron. It may, however, be produced at any time artificially, by exposing white cast iron, particularly of that quality that merges on the steel-grained, in an open or covered furnace for some time to the action of a red heat, the time of exposure to be commensurate to the thickness of the iron employed. This operation has the effect of discharging the white or lamellar fracture, and substituting in its place one of a grayish colour, very dense, and minutely steel-grained, the process itself being one of decarbonization, and which, from its colour and softness under the file, ought not to be taken, as it sometimes is, for a manifestation of an increased quantity of carbon in the iron.

2ndly, as white cast iron occupies a position between steel-grained and graphite or gray iron, and is frequently found merging in both, it of course possesses a variety of quality and character greater than either of the other two, so as to render the details of experiments made with this variety of the metal subject to greater uncertainty than with the graphite or steel-grained.

Dr. Ure has assigned no definite quantity of carbon to the steel-grained iron, but that, in his estimation, it possesses a notable proportion, may be gathered from what follows: he assigns to white cast iron a maximum dose of 5¼ per cent., and further states that with a proportion of 4½ per cent. it still retains its white or lamellar fracture. So that in the absence of more correct data, it may be inferred that when the change to steel-grained iron has taken place, the iron has lost 1 per cent. and still retains about 3½ per cent. of carbon, so that as it regards carbon, the iron is in the same situation with good foundry iron, but observe the difference when this theory is tested by practice—the foundry iron will melt in an air furnace, and come out as fluid as water, while the steel-grained iron, under the same circumstances would not melt at all, but pass rapidly into the state of malleable iron.

3rdly, graphite or gray cast iron first makes its appearance by small dark specks inserted on the fracture of the white iron, and at this stage it is said to be mottled when those specks cover the entire surface, and receive, from the addition of more carbon, some degree of lustre, the iron is said to be bright gray; as the fracture becomes more open, and the colour darker, it is called dark gray iron; and when uniformly open throughout with a smooth surface, it is called best foundry iron.

Hitherto it had been supposed and believed that white cast iron contained a much less quantity of carbon—that the change of fracture from white to gray was in consequence of the iron absorbing or becoming united with a large share of that substance—that whatever carbon white iron contained, the graphite was so much in addition, and never considered as a symptom of its abatement.

Dr. Ure, however, holds a contrary opinion; according to him, the greatest quantity of carbon which can be united to the metal is in the state of white iron, and may be to the extent of 5¼ per cent, as the iron becomes more gray by the addition of carbonaceous matter in the furnace, the quantity of carbon in it diminishes inversely to 3½ or 4 per cent. This I confess is a paradox of difficult solution, as it involves, to a certain extent, the operation of substracting during a process of repeated additions.

Independent of this, the new theory is to me abundantly perplexing, as the student has to deal with carbon in a considerable variety of states with which he had not been formerly familiar. We have "free carbon, residuum of plumbago and carbon, graphite or plumbago, combined carbon, carbon unaltered, carbon in mechanical mixture, carbon in a state of alteration, &c." The most of this is new and strange to me, but I may inquire whether Dr. Ure ever separated carbon from cast iron by mechanical means that were not magnetic.

Were the new theory true, we should be obliged to abandon the old legitimate conclusion that iron and steel were fusible in proportion to the carbon they contained, but now inversely, seeing white pig iron, which is said to contain the most carbon, is much more infusible than gray iron.

The process of refining pig iron for the manufacture of bar iron, would, under Dr. Ure's system, be no longer a decarbonating operation, but the reverse; for when the gray pig iron introduced into the furnace, had acquired the white or lamellar fracture, it would be found to have absorbed or taken up $1\frac{83}{100}$ of carbon in addition, being the difference between 3½, the utmost that forge iron may be supposed to contain, and 5¼, the quantity assigned to white iron, and this during an operation of the most severe decarbonization with which we are acquainted.

In like manner, suppose a founder was to charge his air-furnace with 2000 lb. or any other quantity of gray pig iron, which is known to contain 3½ per cent. of carbon by repeated fusions, accompanied with a considerable loss of iron, it would at last become possessed of the white or lamellar fracture, and have acquired nearly 2 per cent. more of carbon while passing through a repetition of consecutive fusions. To believe this for one moment appears to me the climax of absurdity.

Again, in the blast furnace a comparatively limited quantity of coke only is necessary merely to fuse the charge, and cause the whole to flow in one common slag, without any portion of the iron being separated. More coke, that is carbon, is added, separation takes place, the iron becomes white, and partakes of the lammelated fracture, and may at that period be supposed to contain the maximum dose of 5¼ per cent. of carbon. The manufacturer, aiming at a more profitable result, adds more and more carbon in the furnace, until he has attained his object as to quality; but, according to the new doctrine, while he has been adding carbon in the furnace, it has been uniformly diminishing in the pig iron.

The pig iron maker might naturally put the following questions: if white pig iron absorbs 5¼ per cent. of the fuel by weight, how is it that this augmentation is not felt in the yield of our ores, but quite the contrary, whereas, when the furnace is making gray iron, the yield from our ores is considerably better?

The operator in the laboratory may be apt to doubt and inquire how it is that, after obtaining his metallic result in white cast iron, and with a fine gloss, he can at any time, by the addition of charcoal, augment the produce of his ore from 1 to 3 per cent. This fact has been known and acted upon by myself for at least 10 years, so that when carburetted results have been obtained beyond the range of the blast furnace, an allowance has been made in the yield of the ore for their extra dose of carbon.

The steel iron maker of Hindostan might well call in question the truth of the new theory upon the most solid and philosophic grounds; for were it so that white cast iron contained more carbon than gray iron, he would decidedly make white iron in preference, for he could do it for for one third of its present cost for charcoal; but he has continued for ages to make gray iron, for the best of all reasons, viz., that his customers can, with gray iron, convert into steel a greater quantity of malleable iron than they can with white.*

On the same grounds I make no doubt that Agricola understood the secret of making iron like the East Indian (gray cast iron), for the purpose of converting, by steeping therein his malleable iron, into steel, and on the same principle, namely, that of its possessing more carbon to communicate to the iron.

I shall, for the present, furnish no further objection to the theory of Drs. Ure and Karsten, but conclude by stating the following facts as being finally conclusive against it:—quantities of gray cast iron, white cast iron, and steel-grained cast iron, were reduced to powder so small as to pass a sieve containing 900 holes in the square inch of its surface, my purpose being to form a species of metallic charcoal to be used in the reduction of an ore of iron, confident that that iron which contained the greatest proportion of carbon would revive from the ore the greatest per centage of iron. A micaceous ore was used in preference, from its presenting more surface to the iron, and which contained 70 per cent. of iron; with the powder made from gray iron 40 per cent. was on the average obtained from the ore, besides making good the weight of the original quantity of iron introduced into the crucible, whereas, when the same experiment was carried into effect with the white and steel-grained iron, not only was there no yield obtained from the ore, but the original iron had sustained a loss varying from 4 to 8 per cent.

I will now make a few final remarks upon the subject of the alleged quantity of carbon contained in steel, on which subject I find my opinions as widely different from those of Drs. Karsten and Ure as upon the proportion which they allege is contained in white cast iron, and which has been aluded to at large in my former communications on this subject.

Dr. Karsten, whom Dr. Ure quotes upon most occasions on the subject of iron and steel, says that he has found the proportions of carbon in steel vary from 1¼ to 2¾ per cent.; now in noticing this latter proportion, I have no hesitation in saying that 2¾ per cent. of carbon united with iron would not form steel at all, but white cast iron. Again, it is said that the proportion in blistered steel reaches, sometimes, but never exceeds, 1¾ per cent., so that we are led to infer that some sort of steels contains 1 per cent. more carbon than that which is said to be contained in steel of cementation. According to my knowledge and view of the matter, steel of any sort united with 1¾ per cent. of carbon, would not at any degree of heat extend under the hammer, or be applied to any useful purpose. 1¾ per cent. would be

* See my Papers on Iron and Steel, page 670.

nearly equal to $\frac{1}{77}$ part the weight of the iron; now $\frac{1}{60}$ part the weight of iron of charcoal fused with Swedish charcoal bar iron on the scale of manufacture, affords cast steel of a very high quality, which requires careful working at a low red heat to convert it into form; any increase of charcoal beyond this proportion would entirely destroy its ductility, either cold or hot. Should an adequate allowance be made for the waste which the charcoal must unavoidably undergo in the crucible, before the affinity is established between it and the bar iron, and for the moisture which, in common with all charcoal, it contains, probably not more than $\frac{1}{3}$ of its weight becomes united to the iron in the process of fusion.

In proof that Dr. Karsten's estimate of the proportions of carbon forming steel is excessive, I refer to the celebrated Bergman's analysis of Swedish steel iron and steel. According to him, the proportion of carbon in steel is (or $\frac{1}{200}$ part) - - ·50
Carbon originally in the iron - ·12

Taken up by the iron in passing into the state of steel, equal $\frac{1}{263}$ part; a proportion very different from those furnished by Dr. Karsten, which range from $\frac{1}{36}$ to $\frac{1}{68}$ - - ·38

A still less proportion of carbon was found in the laborious analyses of four specimens of French steel iron performed by M. Vauquelin, and which seems to have carried the dose of carbon to the opposite extreme.

*Specimen No. 1,	contained of carbon	- -	·110789
Do. 2	do.	- -	·00683
Do. 3	do.	- -	·00789
Do. 4	do.	- -	·00643

I also subjoin a very accurate and interesting analysis made by Mr. Tennant at Glasgow, and inserted in the 6th volume of the transactions of the British Association, of cast steel made from Danamora iron, which, in point of proportion, coincides with my view of the matter:

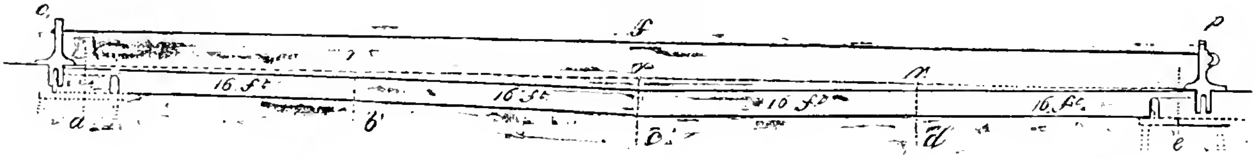
Iron - - - - -	99·288
Manganese - - - - -	·190
Carbon - - - - -	·388
Loss - - - - -	·134
	100· parts.

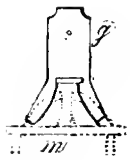
This proportion is equal to $\frac{1}{260}$ part the weight of the steel, and exhibits in a most striking point of view, the minute proportion of carbon which communicates to iron the varied and enduring properties of steel, without which, or some equally powerful substitute, arts and manufactures would soon become stationary.

Your's, &c.,
Coleford, June 17. D. Mushet.

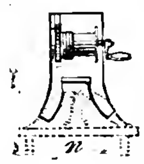
P.S. When Dr. Ure revises the article upon the assay of iron ores, I should recommend him to substitute some other glass or flux for flint glass, as it would be inconvenient and perplexing for the juvenile assayist to have to deal with a button of iron over-riding one of lead, the former containing a little lead, and the latter some iron.

PLATE LAYERS GAUGE LINE.





f, four lengths of 16 feet rails, with the set-ups at *o* and *p*.
o, *p*, the set-ups on the rail with the line fixed, and showing the reel at *p*.
g, *b*, ditto across the ditto.
m, *n*, section of chairs and rail, with the instrument placed.
r, *r*, *r*, top of rail when corrected.



Sir—I take the liberty of handing to you the annexed rough sketch of a plate-layer's line, &c., for the purpose of enabling the plate-layer to keep nearly a correct gradient on the surface of the rails, between two correct heights, at the distance of four or five 16 feet rails. If you think this of any use, or worthy of insertion in your widely circulated Journal, it is at your service, at the same time I beg to say that I am not aware of its ever being applied, but from the best consideration I am able to give on its utility, I am persuaded that it may be applied to advantage, more particularly on railways like the Great North of England, which has so many favourable positions for a great distance in a straight line.

The instrument can be made very portable, and of a light construction, readily fixed on the cheeks of the joint chairs, at any distance required, by merely placing the claws of each set-up on them, no other fastening being required.

One of the set-ups (or gauge) is furnished with a reel and ratch, so that when the line is wound tight, it will be kept from slacking; the line must be made fast to the other 'set-up,' and at equal distance from the top of the rail with the other. When the points at *a* and *e*, (sketch *f*) are connected, the instrument may be then fixed on these places; when the intermediate blocks, &c., at *b*, *c*, and *d*, may be beat up to the proper height, by gauging from the line to the top of rail, (as per dotted line at *f*, *r*;) the line may be so arranged as to stretch from the points *a* and *e*, on the surface of the rail, and the intermediate rails then brought up to the line, so that no gauging would be required, but I believe the first process would answer the best.

Your obedient servant,
M. Q.

York, June 13, 1841.

If you refer to page 181, I wish you to correct an error in the weight of chairs, &c., the following is the correct statement, and should have been inserted:—

Joint chair	- -	40 lb. each.
Middle	- -	30 „
Check	- -	41 „

M. Q.

CHIMNEY FLUES.

Sir—According to the new Act, chimney flues are, in future, not to be less than 14 inches by 9 inches, or (if cylindrical,) 12 inches diameter. Is this meant to apply to the whole extent of the flue? for if so, all chimney-pots, &c., of less diameter are at once condemned; as far as such unsightly terminations are concerned, that will however be no loss; but as experience has proved that when flues exceed a certain size, contraction becomes necessary, at the top at least, to ensure a good draught, if that is henceforth not to be permitted, the fire-places, in order to contain fire enough to rarify the greater column of air that will thus be exposed to its influence, must be enlarged to an inconvenient extent.

Your opinion on the proper construction of the Act, will oblige your obedient servant,

A Subscriber.

N.B. According to Tredgold on this subject, flues seldom ought to be more than 8 or 9 inches in diameter, indeed frequently much less; and when climbing boys are no longer permitted, there can be no objection whatever to making them of any size that the particular case may require; and indeed there never was any objection, since there is no necessity, even now, for using so barbarous a mode of sweeping as is about to be forbidden by law.

[We are of opinion that the Act does not apply to chimney-pots—a chimney-pot is not a flue—the flue terminates with the brick shaft.—Editor.]

* See Mushet on Iron and Steel, and the quarto edition of Nicholson's Journal.

ON THE BUILDING MATERIALS OF THE UNITED STATES OF NORTH AMERICA.

By David Stevenson, Civil Engineer, Edinburgh.

Read before the Society of Arts for Scotland in Session 1841.

There is, perhaps, nothing connected with the useful arts, which has a greater share in forming the characteristic appearance of a country, than the materials which it produces, and of which its public works are necessarily constructed. I use the word *materials* in the technical sense in which it is employed by engineers and architects, to denote the several productions of the mineral and vegetable kingdoms which are used in the construction of engineering and architectural works; and we have only to look around us for a moment, to be at once convinced how much these, in their almost endless variety, affect the appearance, as well as modify the structure, of the public works of every-country.

A good illustration of the truth of this observation presents itself, when we compare the circumstances of Scotland and England in this respect; the former being what may be termed a *stone*, and the latter a *brick* country. To what circumstance can the far-famed beauty of the Scottish metropolis be more reasonably attributed, than to the great abundance of beautiful sandstone afforded by the quarries in its immediate vicinity, to which its street architecture and public buildings are so greatly indebted for their striking appearance. This remark applies, as we are well aware, not only to Edinburgh, but to many other towns in Scotland; while our less highly-favoured neighbours in the south, from the scarcity of good coloured building stone in some districts, and the total want of it in others, are reduced to the necessity of using brick for their dwelling-houses, and in many instances for their public buildings. So generally acknowledged are the fine qualities of the stone from many of the Scotch quarries, that it is exported to a considerable extent. To London itself, indeed, a large quantity of stone is annually sent from Craigleith in Mid-Lothian, which is the largest, and probably the finest sandstone quarry in the world, and of which the dwelling-houses in the New Town of Edinburgh, and most of the public buildings, were in a great measure built.

Many similar illustrations may be found, even in matters of much smaller importance than that to which I have just alluded. In Great Britain, for example, with the exception of some districts in England, the roofs of houses are very generally covered with slates, the greater part of which are supplied by the extensive slate quarries of Bangor in North Wales, and Easdale, Balachulish, and others, on the west coast of Scotland. But Holland has not the advantage of a like supply, and consequently the houses in that country are invariably covered with tiles; and if we extend our observations still further, to Canada and the United States, we there find that the want of more suitable materials for roofing, and the great quantities of fine timber with which those countries abound, have induced the inhabitants to cover their dwelling-houses with wood cut into thin pieces called "shingles," while the spires of the churches, which rise from all the principal towns on the banks of the St. Lawrence, are covered with highly polished tin.

Another of the many illustrations that may be given, appears in the construction of roads—a most important branch of engineering. The roads in this country are now invariably macadamized, as materials hard enough for forming them advantageously on that principle are very generally met with throughout the length and breadth of the island. In France, on the other hand, the want of hard materials renders Macadamizing not so applicable; and consequently, it has not by any means been generally introduced in that country, many of the principal roads being still *pitched* or paved with large stones. In Holland, owing to the scarcity of stones of every description, most of the roads are paved with small well-burned bricks, called "clinkers," which are set in sand, and present an exceedingly smooth surface; while in America and Russia, we find long stretches of "corduroy road," constructed entirely of timber—the produce of their extensive forests, which forms a species of highway by no means so well calculated as any of the others alluded to, for extending communication or promoting the comfort of the traveller; as the painful experience of every one who has travelled on them can abundantly testify.

The materials of every country may therefore be regarded as a subject of great interest connected with its history, and this consideration has induced me to offer a few remarks on the materials employed in the construction of the public works of the United States, in the belief that they may not be uninteresting to the members of a society which has for its object the promotion of the useful arts.

Iron is pretty abundant in North America, and it is worked in several parts of the United States. The only iron-works which I had an opportunity of visiting in the course of a late tour in that country, were those in the neighbourhood of Pittsburg, on the river Ohio, which are said to be the most extensive in America. At this place, the workmen were engaged in the manufacture of pig iron and plate-rails for railroads. The use of plate-rails, however, has been very limited, and as no other description of rail has been manufactured in the country, it has been the practice to import both the rails and chairs for the greater part of the American railroads from Britain, as well as the iron used for some other purposes. The government of the United States, indeed, in order to facilitate the progress of railways, do not exact the duty on iron rails and chairs imported from this country. It may safely be said, that the manufacture of iron in the United States, and what is more closely connected with the subject of this paper, its application to engineering works, are still in their infancy, at least when we regard the great extent and perfection to which these arts have been brought in Britain; and my observations on the materials of the country will therefore be confined to those of masonry and carpentry, as these are in some degree peculiar to the country, and any remarks regarding them will of course be more interesting.

Brick is the building material which is now invariably used in the construction of dwelling-houses in the towns of the United States. Timber is still pretty generally used for houses in the country; but of late years the erection of wooden structures, from their liability to take fire, has been prohibited in the neighbourhood of towns. Clay suitable for brick-making is found in great quantities, which is a fortunate circumstance for the inhabitants; and the bricks, which are burned with wood, and manufactured in other respects like those in this country, generally cost about 6½ dollars or 26s. a thousand.

Experience in our own and in many other countries, has proved that brick is well suited for house-building; but experience has also shown that it is by no means so well adapted as stone for engineering operations generally; and to some works it is with us considered wholly inapplicable. Marble and granite, of which I shall afterwards have occasion more particularly to speak, occur in the northern parts of the United States; but stone easily accessible to the quarrier, and fitted for building purposes, is very rarely to be met with, and the American engineers have therefore been obliged, as is the case in all countries, to adapt the structure of the works to the materials they possess; and in making this adaptation, they appear to have violated many of the established rules of engineering as practised in this country. The scarcity of stone, and the unsuitableness of brick for hydraulic purposes, for example, has forced them to construct most of the locks and aqueducts on the lines of their great canals wholly of timber, with which the country abounds; and that material, ill adapted as it may seem to such a purpose and situation, where it is not only exposed to the constant tear and wear occasioned by the lockage of vessels, but also to the destructive effects of alternate immersion in water and exposure to the atmosphere, has nevertheless been found in practice to form a very good substitute for the more durable materials used for such works in Europe.

Stone.—The quarries of the United States, taking into consideration the great extent of the country and the number of its public works, are, as I have already hinted, few in number; and, generally speaking, the workings are on a small scale. They afford granite and marble, and their produce is almost exclusively applied to facing public buildings, forming stairs, window and door lintels, and to other architectural purposes.

Granite is worked in the northern part of the country at Quincey in the state of Massachusetts, and at Singsing in the state of New York, and also in New Hampshire. The Quincey granite is of a fine gray colour, and can be quarried in large blocks. It has been used a good deal in Boston and the neighbouring country for architectural works. It has also been employed for railway blocks on some of the lines of railway in the neighbourhood of Boston, and in the construction of the only two graving docks which exist in the United States, the one at Boston, and the other at Norfolk in Virginia, the latter at a distance of upwards of 500 miles from the quarries; and these, so far as I am aware, are the only engineering works of any consequence in America in which granite has been employed.

The Singsing granite, which is of a dark gray or bluish colour, is quarried on the banks of the Hudson, about 25 miles from the town of New York, at which place it has been pretty generally used for some time for stairs and lintels, and has lately been introduced for facing buildings. The Astor hotel, the largest in America, and perhaps in the world, which is one of the very few stone buildings in New York, is built of this granite.

In the neighbourhood of Boston, and also Philadelphia, a species of soap-stone is found, which is quarried to some extent, and used in situations exposed to high temperatures instead of fire-brick.

Marble. To the marble quarries, however, the Americans look for their principal supply of materials. These are more numerous, and are more widely distributed than the others I have mentioned, although they also are confined to the northern states. The principal marble quarries are in the states of Pennsylvania, Massachusetts, and Vermont. I visited some of them when in the country, and had also the advantage of receiving much information regarding them, as well as the materials of the United States generally, from Mr. Strickland, architect, at Philadelphia, and from Mr. John Struthers, marble-cutter, of the same place, to whom I am indebted for the specimens of marbles and woods which I had the pleasure of laying before the Society.*

The marble quarries in Pennsylvania are situate in the valley of the river Schuylkill, and are from thirteen to twenty miles distant from Philadelphia. They produce white, blue, black, and variegated marbles. Limestone is found resting on the marble, and is blasted off with gunpowder, and burned for making mortar. In some of the quarries which I visited, the beds of marble dipped from north to south at an inclination of 60° with the horizon, and they were worked at considerable disadvantage. In one quarry the men were working a bed of white marble 14 feet in thickness, at a depth of 120 feet below the natural surface of the ground. The blocks, some of which weighed 12 tons, were raised to the surface by means of a rudely-constructed horse-gin, there being no road to the bottom of the quarry, or rather pit, from which they are taken, by which even a man could conveniently, or safely, descend or ascend, without the use of a rope to prevent his falling headlong to the bottom. In this respect the American marble quarries reminded me of the celebrated sandstone pits of the ancient city of Caen in Normandy, which are not only remarkable as having produced the materials for the old London Bridge, but as presenting a mode of working very similar to that pursued in the coal-pits of this country; the blocks, being excavated at a great depth under the ground, are conveyed in subterranean passages to shafts, through which they are raised to the surface by horse power, as in the American quarries. The price of the American marble varies according to its quality and kind. The carriage of the materials, owing to the badness of the roads, forms a very expensive item in all the public works, and is, of course, regulated by the distance of transport; but the white marble costs about 4s. 10d., and the blue about 4s. per cubic foot at the quarries, and although this may seem a very moderate price for marble, which in this country costs from 15s. to 2l. a cubic foot, still, when used instead of stone throughout the whole thickness of the wall of a dwelling-house, or the pier of a bridge, it becomes, even at the lower price I have mentioned, a costly material.

The Massachusetts quarries, which are at a place called Stockbridge, produce white and blue marbles, and the Vermont quarries, which are near Lake Champlain, furnish black and white marbles.

Those I have enumerated are the principal quarries in the United States; but from the circumstances of their being so much confined to particular localities, and the manner in which they are worked, it is evident that their produce cannot be applied by any means to the general wants of the country; and consequently, excepting in the case of buildings on which a good deal of money is to be expended, it is but little employed, the cost of the material itself, and the expense of carriage, being very considerable.

The marbles of the United States, according to the account of many intelligent Americans with whom I conversed on the subject, are not suited for sculpture or very fine ornamental works, or even, indeed, for the capitals of columns, which require superior workmanship; and the marble used for the capitals of all the fine buildings throughout the country is imported from Carara in Italy, whence a very large quantity is annually exported to America. For similar purposes black marble is also imported into the States from Ireland. If, however, I might form a judgment from the quality of some of the specimens which I procured, I should think that were the American quarries efficiently worked, there could be very little necessity for applying either to Italy or Ireland for so great an annual supply. Those buildings which are constructed of the whitest description of American marble carefully selected for the purpose, such as the Capitol and the President's house at Washington, the Bank of the United States, the Mint, and other public buildings at Philadelphia, and the monument erected to the memory of Washington at Baltimore, have certainly a most imposing and gorgeous appearance, owing to the fineness and beauty of the material. But the buildings which are constructed of the blue or unselected marble, such, for example, as the State Capitol at Albany, or the Town-House at New York, have a bloated and dingy look, and the general effect produced by the marbles in these buildings is greatly inferior to that of some of the sandstones from Craigleith and other British quarries.

The white marble retains its purity of colour much longer in the United States than it would do in this country, owing to the clearness of the atmosphere and the absence of smoke, the use of anthracite coal, which produces no smoke during combustion, being common in most of the towns. These circumstances may also account for the seemingly permanent vividness of the various colours, such as red, white, brown, yellow, and green, with which, according to the taste, or rather want of taste, of the occupiers, the exteriors of the brick houses in New York, and many other towns in the United States, are generally painted.

Timber.—I must now make haste to speak of the materials of carpentry, the other department regarding which I proposed to offer a few remarks.

The forests, to the British eye, are perhaps the most interesting features in the United States, and to them the Americans are indebted for the greater part of the materials of which their public works are constructed. These forests are understood to have originally extended, with little exception, from the sea-coast to the confines of the extensive prairies of the western states: but the effects of cultivation can now be traced as far as the foot of the Alleghany Mountains, the greater part of the land between them and the ocean having been cleared and brought into cultivation. It is much to be regretted that the early settlers, in clearing this country, were not directed by a systematic plan of operations, so as to have left some relics of the natural produce of the soil, which would have sheltered the fields and enlivened the face of the country, while at the same time they might, by cultivation, have been made to serve the more important object of promoting the growth of timber. Large tracts of country, however, which were formerly thickly covered with the finest timber, are now almost without a single shrub, every thing having fallen before the woodman's axe; and in this indiscriminate massacre there can be no doubt that many millions of noble trees have been left to rot, or, what is scarcely to be less regretted, have been consumed as firewood. This work of general destruction is still going forward in the western states, in which cultivation is gradually extending; and the formation of some laws regulating the clearing of land, and enforcing an obligation on every settler to save a quantity of timber, which might perhaps be made to bear a certain proportion to every acre of land which is cleared, is a subject which I should conceive to be not unworthy of the attention of the American Government, and one which is intimately connected with the future prosperity of the country. But should population and cultivation continue to increase in the same ratio, and the clearing of land be conducted in the same indiscriminate manner as hitherto, another hundred years may see the United States a *treeless* country. The same remarks apply, in some measure, to our own provinces of Upper and Lower Canada, in many parts of which the clearing of the land has shorn the country of its foliage, and nothing now remains but blackened and weather-beaten trunks.

The progress of population and agriculture, however, has not as yet been able entirely to change the natural appearance of the country. Many large forests and much valuable timber still remain both in Canada, and in the United States: the Alleghany Mountains, as well as other large tracts of country towards the north and west, which are yet uninhabited, being still covered with dense and unexplored forests.

The timber trade of the United States and of Canada, from the quantity of wood which is required for home consumption and exportation, is a source of employment and emolument to a great mass of the population. It is carried on to a greater or less extent on all American rivers, but the Mississippi and the St. Lawrence are more especially famous for it. The chief raftsmen, under whose direction the timber expeditions on these rivers are conducted, are generally persons of great intelligence, and often of considerable wealth. Sometimes these men, for the purpose of obtaining wood, purchase a piece of land, which they sell after it has been cleared; but more generally they purchase only the timber from the proprietors of the land on which it grows. The chief raftsman and his detachment of workmen repair to the forest about the month of November, and are occupied during the whole of the winter months in felling trees, dressing them into logs, and dragging them with teams of oxen on the hardened snow, with which the country is then covered, to the nearest stream. They live during this period in temporary wooden huts. About the middle of May, when the ice leaves the rivers, the logs of timber that have been prepared and hauled down during winter, are launched into the stream, and being formed into rafts, are floated to their destination. The rafts are furnished with masts and sails, and are steered by means of long oars, which project in front, as well as behind them; wooden houses are built on them for the accommodation of the crews and their families. I have several times, in the course of the trips

* These specimens are now in the museum of the Society of Arts.

which I made on the St. Lawrence, counted upwards of thirty men working the steering oars of the large rafts on that river, from which some idea may be formed of the number of their inhabitants. Those rafts are brought down the American rivers from distances varying from one hundred to twelve hundred miles, and six months are often occupied in making the passage. When it is at all possible, they moor them during the night in the still water at the edge of the river, but when this cannot be done, they continue their perilous voyage in the dark, exhibiting lights at each corner of the raft to warn vessels of their approach to them. The St. Lawrence rafts vary from 40,000 to 300,000 square feet, or from about one to no less than seven acres in surface, and some of them contain as much as £5000 worth of timber. If not managed with great skill, these unwieldy specimens of naval architecture are apt to go to pieces in descending the rapids, and it not unfrequently happens that the labour of one, and sometimes two seasons is in this way lost in a moment. An old and experienced raftsman, with whom I had some conversation on board of one of the St. Lawrence steamers, informed me that he, on one occasion, lost £2500 by one raft which grounded in descending a rapid and broke up. He said the safest size for a raft was from 40,000 to 50,000 square feet, or about one acre, and that five men were required to work a raft of that size.

The species of forest trees indigenous to different countries is an interesting subject connected with vegetable physiology. There are said to be about thirty forest trees indigenous to Great Britain, which attain the height of thirty feet; and in France there are about the same number. But according to the best authorities, there are no less than 140 species which attain a similar height indigenous to the United States.

To notice each of these numerous species, whose timber is employed by the Americans in the arts, even if I were able to do so, would greatly exceed the limits to which I am restricted by the nature of the present communication, and I shall therefore only make a few remarks regarding those timbers which are most highly prized and most extensively used in the ship carpentry and public works of the country.

The first which I shall notice is the Live Oak (*Quercus virens*), so named because it is an evergreen, its leaves lasting during several years and being partially renewed every spring. It grows only in the southern states, and is one of the most valuable of the American timbers. The duty imposed by our government on wood from the United States, prevents its importation into Britain, and as live oak grows only in the United States and is not found in Canada, it consequently never reaches this country as an article of commerce; the whole produce being consumed by the Americans themselves in shipbuilding. Its specific gravity is equal to, and in some cases greater than, that of water, and it is used along with white oak and cedar for the principal timbers of vessels. The climate, according to an American authority,* becomes mild enough for its growth near Norfolk in Virginia, though at that place it is less multiplied and less vigorous than in more southerly latitudes. From Norfolk it spreads along the coast for a distance of 1500 or 1800 miles, extending beyond the mouths of the Mississippi. The sea air seems essential to its existence, for it is rarely found in the forests upon the mainland, and never more than fifteen or twenty miles from the shore. It is most abundant, most fully developed, and of the best quality, about the bays and creeks and on the numerous fertile islands which lie scattered for several hundred miles along the coast. The live oak is generally forty or fifty feet in height, and from one to two feet in diameter, but it is sometimes much larger, and its trunk is often undivided for eighteen or twenty feet. There can be little doubt, from its great density and durability, that this is one of the finest species of oak that exists, surpassing even that for which Great Britain is so famous. Its cultivation has been tried in this country without success; but could it be imported, it would be found admirably suited for the construction of lock-gates and other engineering works, for which hard and durable timber is required, and for which English or African oak is generally used.

The White Oak (*Quercus alba*) is the species of which so much is imported into this country. It is known by the name of "American oak," but it is a very different and much inferior wood to the live oak of the United States which I have just described. It is also much more widely distributed, and occurs in much greater quantity, than the live oak. It is very common throughout the northern states and in Canada, from whence it is exported to this country. It attains an elevation of seventy or eighty feet, with a diameter of six or seven feet. It is known by the whiteness of its bark, from which it derives its name, and from a few of its leaves remaining on the branches in a withered state throughout the winter. The wood is of a reddish colour, and in that respect is very similar to English oak. But it is generally acknowledged to be greatly inferior to it in strength and durability. It is very straight in the fibre, however, and can be got in pieces of great length and considerable scantling—properties which, for certain purposes, make it preferable to the British oak. It is much used in ship-building, and also for the transverse sleepers of railways. There are many other oaks in the United States, but the two I have mentioned are those most in use.

The pines are perhaps the next woods in importance to the oaks. The species of those are also very numerous, and I shall only mention one or two of the most important of them.

The White, or Weymouth Pine (*Pinus strobus*), is widely distributed both in the United States and in Canada, and is exported to Britain in great quantities from the latter country. It is the tallest tree of the American forest, having been known, according to Michaux, to attain the height of 180 feet. The wood has not much strength, but it is free from knots, and is easily wrought. It is very extensively employed in the erection of bridges, particularly *frame* and *lattice* bridges, a construction peculiar to the United States, and very generally adopted in that country, which I have described in detail elsewhere.* For this purpose it is well fitted, on account of its lightness and rigidity, and also because it is found to be less apt to *warp* or *cast* on exposure to the atmosphere than most other timbers of the country. It is much used for the interior fittings of houses, and for the masts and spars of vessels.

The Yellow Pine (*Pinus mitis* or *variabilis*) occurs only in the southern and middle states, and is not found in Canada, and therefore does not reach this country, the wood known by that name in Britain being the *Pinus resinosa*. It attains the height of 50 or 60 feet, with a diameter of 2 or 3 feet, and is the timber which the Americans employ in greatest quantity for the masts, yards, booms, and bowsprits of their vessels. A large quantity of it is annually consumed for this purpose in the building-yards of New York, Philadelphia, and Baltimore.

The Red Pine (*Pinus resinosa*) is the only other of the pine species that is much used. It occurs in great plenty in the northern and middle states, and in Canada, from whence it is exported in great quantity to this country, and it is known to us by the name of "American yellow pine." It attains the height of 70 to 80 feet, with a diameter of two feet, and is remarkable for the uniform size of its trunk for two-thirds of its height. Its name is derived from the redness of its bark. The wood, owing to the resinous matter it contains, is heavy; and is highly esteemed for naval architecture, more especially for decks of vessels, both in this country and in America.

The Locust (*Robinia pseud-acacia*), from the beauty of its foliage and the excellent qualities of its timber, is justly held in great esteem in America. It abounds in the middle states, and in some situations attains the height of seventy feet, with a diameter of four feet. The wood of the locust tree is of a greenish yellow colour, marked with brown veins, not unlike the laburnum of this country. It is a close-grained, hard, and compact wood, and is of great strength. It is used, along with live oak and cedar, for the upper timbers of vessels, and is almost invariably used for treenails, to which it is well adapted. It is also employed in some parts of the country as transverse sleepers for railways. Its growth being chiefly confined to the United States, it is not imported into Britain. It is one of the very few trees that are planted by the Americans, and may be seen forming hedge-rows in the highly cultivated parts of Pennsylvania.

The Red Cedar (*Juniperus Virginiana*) is another valuable wood, the growth of which is confined to the United States. In situations where the soil is favourable it grows to the height of 40 or 50 feet, with a diameter of 12 or 13 inches. This wood is of a bright red colour; it is odorous, compact, fine-grained, and very light, and is used, as already stated, in ship-building, along with live oak and locust to compensate for their weight. It is considered one of the most durable woods of the United States, and being less affected by heat or moisture than almost any other, it is much employed for railway sleepers. I remember, in travelling on some of the railways, to have been most pleasantly regaled for miles together, with the aroma of the newly laid sleepers of this wood. It is now, however, becoming too scarce and valuable to be used for this purpose.

The White Cedar (*Cupressus thyoides*) and the Arbor Vitæ (*Thuja occidentalis*) are employed for sleepers and other purposes to which the red cedar is applied, but the latter is preferred when it can be obtained.

The only other tree which I shall notice is the Sugar Maple (*Acer saccharinum*) which occurs in great abundance in Canada and the

* The Sylva Americana, by J. D. Browne. Boston, 1832.

* Stevenson's Sketch of the Civil Engineering of North America. London: John Weale, 1838.

northern states. It attains the height of 50 or 60 feet, and is from 12 to 18 inches in diameter. The wood of this tree is soft, and when exposed to moisture it soon decays. It is very close-grained, and when cut in certain directions is remarkably beautiful, its fibres, owing to their peculiar arrangement, producing a surface variegated with undulations and spots. It is also susceptible of a very high polish. These qualities tend to render it a valuable acquisition to the list of American woods for ornamental purposes, for which it is very generally employed, and is well known in this country by the name of "Bird's Eye Maple." The wood of the Red-flowering Maple (*Acer rubrum*) is also employed for ornamental purposes, and is generally known by the name of "Curled Maple." The cabins of almost all American-built vessels are lined with these woods, or with mahogany inlaid with them, and they are also much used for making the finer parts of the furniture of houses.

The property of the sugar maple, however, from which it derives its name, is of perhaps more importance in a commercial point of view than its use as timber. I allude to its property of distilling a rich sap, from which sugar is largely manufactured throughout the United States. From two to four pounds of sugar can be extracted annually from each tree without hurting its growth. I had an opportunity of making some inquiries regarding this simple process when on the banks of the river Ohio, where I saw it in progress. One or two holes are bored with an augur, at the height of about two feet from the ground, and into them wooden tubes, formed of the branch of some soft-hearted tree hollowed out, are inserted. The sap oozing from the maple flows through the tubes, and is collected in troughs. It is then boiled until a syrup is formed of sufficient strength to become solid on cooling, when it is run into moulds and is ready for use.

Such is a brief notice of some of the principal timbers of the United States, which, from their great abundance and variety, are suitable for almost every purpose connected with the arts, and thus serve in some degree to compensate for the want of stone, while at the same time they afford great advantages for the prosecution of every branch of carpentry, an art which has been brought to great perfection in that country. Many ingenious constructions have been devised to render timber applicable to all the purposes of civil architecture, and in no branch of engineering is this more strikingly exemplified than in bridge-building. Excepting a few small rubble arches of inconsiderable span, there is not a stone bridge in the whole of the United States or Canada. But many wooden bridges have been constructed. Several of them, as is well known, are upwards of a mile and a quarter in length, and the celebrated Schuylkill Bridge at Philadelphia, which was burnt about two years ago, but was in existence when I visited the country, consisted of a single timber arch of no less than 320 feet span. Canal locks and aqueducts, weirs, quays, breakwaters, and all manner of engineering works have there been erected, in which wood is the material chiefly employed; so that if we characterize Scotland as a stone and England as a brick country, we may, notwithstanding its granite and marble, safely characterize the United States as a country of timber. I shall only, in conclusion, very briefly allude to the appearance of the American forests, of which so much has been written and said; and on this subject I may remark, that it is quite possible to travel a great distance without meeting with a single tree of very large dimensions; but the traveller, I think, cannot fail very soon to discover that the average size of the trees is far above what is to be met with in this country. I measured many trees, varying from 15 to 20 feet in circumference, and the largest which I had an opportunity of actually measuring was a Button-wood tree (*Platanus occidentalis*) on the banks of Lake Erie, which I found to be 21 feet in circumference. I saw many trees, however, in travelling through the American forests, which evidently far exceeded that size, and which my situation, as a passenger in a public conveyance, prevented me from measuring.

M. Michaux, who has written on the forest trees of America, in speaking of their great size, states, that on a small island in the Ohio, fifteen miles above the river Muskingum, there was a button-wood tree, which, at five feet from the ground, measured 40 ft. 4 in. in circumference. He mentions having met with a tree of the same species on the right bank of the Ohio, thirty-six miles above Marietta, whose base was swollen in an extraordinary manner; at four feet from the ground it measured 47 feet in circumference, giving a diameter of no less than 15 feet 8 inches; and another of nearly as great dimensions is mentioned by him as existing in Genessee; but these trees had perhaps been swollen to this enormous size from the effects of some disease. He also measured two trunks of white or Weymouth pine, on the river Kennebec, in a healthy state, one of which was 154 feet long and 54 inches in diameter, and the other was 142 feet long, and 44 inches in diameter, at three feet from the ground. M. Michaux also measured a white pine which was 6 feet in diameter, and had reached probably the greatest height attained by the species, its top being 180 feet from the ground. It is difficult for an inhabitant of our island, without having seen the American forests, to credit the statements which have been made by various authors, as to the existence of these gigantic trees of 180 feet in height (being about 40 feet higher than Melville's monument in St. Andrew Square, in Edinburgh): but such trees undoubtedly do exist. Mr. James Macnab of the Royal Botanic Garden, in a paper on the local distribution of different species of trees in the native forests of America,* mentions having measured numerous specimens of the *Pinus strobus* in Canada, which averaged 16 feet in circumference, and 160 feet in height: and one specimen which had been blown down, and of which the top had been broken off, measured 88 feet in length, and even at this height was 15 inches in diameter.

The ascent of the sap in trees is a subject which has long occupied the attention of physiologists. Some difference of opinion, however, exists regarding it, and hitherto it is believed no very definite conclusions have been arrived at;—and although not strictly connected with the subject of this paper, I may be excused for remarking, that the quantity of sap required to sustain such enormous trees as these I have been describing, and the source and nature of the power by which a supply of fluid is raised and kept up, at the great height of 180 feet from the ground, are inquiries which, could they be satisfactorily solved, would form most interesting and instructive additions to our knowledge regarding vegetable physiology.

Edinburgh, February, 1841.

* Agricultural Journal for 1835.

ON THE SYSTEM OF WARMING BUILDINGS BY HOT WATER.

A Reply to Mr. Perkins's "Answer" (in the Journal for June last, p. 201,) to the Report presented to the Manchester Assurance Company. By John Davies, and George Vardon Ryder.

Mr. Perkins declaims against our "unfair report;" and charges us with "errors and misstatements," with "manifest absurdity," with "unjust and absurd experiments," "conducted with any view rather than that of candid investigation." Such charges are easily made on either side of a discussion, and are most generally resorted to by those who are least warranted in applying them. We shall presently show how unmerited and irrelevant such charges are in reference to us; and we trust that we shall be enabled to satisfy every disinterested reader, that Mr. Perkins has, in order to conceal the weakness of his defence, indulged his feelings in this kind of phraseology, which, from the facility with which he uses it, seems to be quite natural to him. It usually happens, as in this case, that the use of such language leaves every thing untainted but the reputation of him who utters it; while it forfeits every claim upon an opponent for any greater courtesy of expression in reply than the example would suggest, or the nature of the objections appear calculated to excite.

Our directions, as the reader of the preceding pamphlets will remember, were "to inquire into the *nature of the accidents which have* recently *occurred* from the use of the hot water apparatus; and to institute a personal investigation into some of the cases referred to; and to make such experiments as might tend to satisfy our minds as to the *causes* of the *accidents which had occurred*" from the use of the apparatus as it has been erected in Manchester, and *not* as it may have been since improved by the Patentee; for the latter being unknown until very "recently," that is to say, until our Report had appeared, it was impossible for us to notice.

We had to investigate the abuses, as well as the uses of the apparatus, as hitherto put up in this town and neighbourhood; for, if the abuses were likely to be of frequent, or even occasional occurrence, if they could arise from ordinary carelessness or mismanagement, it is clear that the danger to property must be very considerable. Of the advantages of Mr. Perkins's "recent" improvement we know nothing excepting what he tells us in his "Answer;" but, how ill soever he may think of us, we do most sincerely assure him, that if it really renders the apparatus secure, we shall hail its application with much pleasure; not altogether with a feeling of satisfaction, resulting from the consciousness that we have hastened, if not occasioned it, by having proved that it was necessary. From his own showing, therefore, Mr. Perkins ought, in this case, to be grateful, rather than angry. We have given to the apparatus a popularity which it did not previously possess, while we have pointed out its defects; these defects Mr. Perkins affirms that he has "recently" completely removed; and, therefore, the very detection of his former errors has tended to diffuse more widely a knowledge of his present state of perfection. Had an "opportunity" been "afforded" to Mr. Perkins "of assisting" us in our "experiments," it is far from probable that he would ever have obtained these advantages, of the source of which he so unreasonably complains.

It seems to be almost impossible to satisfy Mr. Perkins. At first he condemns us because we attended to "appearances;" and he afterwards inveighs against us because we resorted to "experiments:" it is, therefore, difficult to conceive how we should have proceeded to form our Report, unless by an implicit reliance upon his assertions, which certainly do not, in some cases, rest upon either appearances or experiments.

The great gist of the charges against us is, that we employed in our experiments an apparatus improperly constructed; for he says, "the patentee *utterly disclaims the apparatus experimented upon* by Messrs. Davies and Ryder as his, any further than that the pipes were closed in all parts."—This charge assumes a very imposing aspect; and if we had done designedly that which he here imputes to us, we should indeed have been highly culpable. From a few facts the reader may judge of the truth of the allegation. Mr. Perkins sold some time ago to Mr. Walker the patent right to the apparatus for Manchester and the vicinity. When we were professionally engaged by the Directors of the Assurance Company, we first inspected the premises which had been recently injured; and then, previously to the performance of any experiments, applied to Mr. Walker to see what information or assistance he was able and willing to afford. Mr. Walker acceded, in the most obliging manner, to our application; accompanied us to some establishments where the apparatus was in operation; and promised to get erected on his own premises, and under his own superintendence, a suitable apparatus, on Mr. Perkins's system, for the express purpose of our experiments. Some little delay occurred; and, as it happened, Mr. Walker had in the interval several interviews on the subject with Mr. Perkins, to whom our investigation was no secret! The apparatus was at length put up; the form and the proportion of the parts were precisely those which Mr. Perkins had taught Mr. Walker, and on the same principle which had guided Mr. Walker in others which he had erected, and might be called upon to erect; and was, therefore, in every respect as essentially on "Perkins's System" as any of those which have been yet introduced into any building in Manchester. In short, Mr. Walker made the apparatus; we the experiments. In all the operations we had the assistance of Mr. Walker's intelligent Foreman, and that of other persons belonging to his establishment.

Mr. Perkins does not find fault with 26 feet of coil in the furnace, though he forgets that only 21 feet, as stated, were exposed to the fire, a fact which, being in his favour, he conveniently suppresses; but he seizes with avidity upon a presumed deficiency in the expansion pipe, insisting that from the proportions in the diagram annexed to the Report, it must have been "six inches less than the apparatus required." Now, even in this plausible objection a slight inadvertency on our parts has rendered him unfortunate; for the diagram having been originally drawn from dimensions given by one of Mr. Walker's assistants was, as it happened, six inches less than it was found, on actual admeasurement, to be in the apparatus really employed in the experiments performed.

It is asserted in the "Answer" that "in the *absence of Mr. Walker* a stopcock was introduced, which, cutting off the greater part of the circulation, left only 40 feet of the tubing out of the furnace to carry off all the heat that could be communicated from 26 feet within it." This is a grave charge; but like the others, it rests entirely upon Mr. Perkins's vivid imagination. A reference, however, to our diagram, which, by singular ill luck is, whether correct or incorrect, a stumbling-block to Mr. Perkins, will clearly show that instead of 40 feet of tubing there were 140, with 21 feet only exposed to the action of the fire! As to the stopcock, it is sufficient to remark that it was contrived and attached by Mr. Walker himself!

Mr. Perkins, in his allusions to his safety valve, places himself in an awkward dilemma. Such an addition is either necessary or it is not: if unnecessary, then it renders the apparatus no better than it was previously; but if it is really necessary, what are we to think of the person who has been until "recently" endangering, by his own acknowledgment, in his "some hundreds of apparatus," life and property to an unlimited extent? What are we to think of him who could, knowingly, leave such places as Messrs. Crafts and Stell's unsupplied with an essential protection? Did he carefully and promptly impress Mr. Walker with its great importance?

We have reason to believe that this gentleman was not acquainted with it previously to the publication of our Report. It appears, then, that Mr. Perkins sold for Manchester and the vicinity an apparatus which he has, for some time, known to be dangerous, and against which danger he did not warn either Mr. Walker or his customers until he produced his "Answer" to our statements. The public have, therefore, derived some information from our Report, whatever may be the advantage which the "Answer" has conferred upon its author.

Mr. Perkins rallies us very much for having said that the experiments made at the Natural History Museum, and at Messrs. Vernon and Co.'s, were "unsatisfactory." Whatever may be his opinion, we regard it as unwarrantable to make experiments, even with his apparatus, where other people's property might be endangered. That was, we can assure him, the reason which induced us to afford him this opportunity for the display of his pleasantry.

When he taunts us, so humourously, in reference to the explosion, by saying, to our discomfiture, that "some grey calicoes spread round the furnace were alone wanting to complete the scene, and put the finishing touch to this exquisite specimen of 'Perkins's Hot Water Apparatus,'" he forgets that this experiment was so amply illustrated in the warehouse of Messrs. Crafts and Stell, that it could not, by possibility, be rendered more striking by repetition. This is a portion of his "Answer," in which he is peculiarly jocular; as if the destruction of "grey calicoes" by fire, and the consequent loss of a great amount of valuable property, were a most amusing exhibition. It can only be compared to the case in which Nero fiddled while Rome was burning. This sort of wit may induce an enemy to smile, but it must, certainly, make a real friend look very serious.

An attempted explanation of an unexpected phenomenon is pronounced to be a "manifest absurdity," because, as Mr. Perkins positively avers, "it is impossible that increase of heat can be produced by the condensation or cooling of steam!!" He must surely have intended this statement as a piece of irony to relieve a dull discussion; for, if he had really any doubts upon the subject, he might have easily and readily proved that the very reverse of his assertion is the fact; and if that failed to satisfy him, he might have demonstrative evidence whenever he may pay his contemplated visit to Manchester.

Mr. Perkins might on this point have consulted authority. An author who treats of his system, and with whose work he may be supposed to be acquainted, says, that "the specific heat of condensed steam, compared with [that of] water, is, for equal weights, as ·847 to 1: but the latent heat of steam being estimated at 1000°, we shall find the relative heat attainable from equal weights of condensed steam, and of water, reducing both from the temperature of 212° to 60°, to be as 7·425 to 1."

Mr. Perkins afterwards says, that "another observation from which erroneous conclusions are drawn," (of course from an error in the premises,) "is that the temperature of the pipes, is influenced by the variation of their internal diameter: this is not the case; the amount of heat conducted off depends on the surface exposed to the atmosphere, and not upon the internal diameter:" from which all that can be inferred is, that Mr. Perkins's pipes must be of a very peculiar kind, when, all other things being the same, the internal diameter affords no indication of their magnitude.

Mr. Perkins tries to evade another explanation by the assurance that "the expansive power of hydrogen gas is far less than that of water." Let us examine this singular statement. Professor Graham, of the London University, says, "Hydrogen gas, steam, and the vapour of sulphuric ether, expand in the same proportion as air."—"The expansion by heat of the different forms of matter is exceedingly various. By being heated from 32° to 212°,

1000	cubic inches of iron become	1004
1000	.... water......	1045
1000	.... air........	1375

Gases are, therefore," he adds, "more expansible by heat than matter in the other two conditions of liquid and solid." Thus Mr. Perkins rests his objection on the assumption that 1000 increased by 375 is "far less" than 1000 increased by 45! The reader can now judge for himself how much, in even this simple case, Mr. P. knows of the properties of the agents which his apparatus requires, and of those which it is liable to bring into action.

Mr. Hood, in treating of the hot water apparatus, says that "a most material difference of temperature occurs in the several parts of the apparatus;" a fact, which we have attempted to explain, but the very existence of which Mr. Perkins denies. It is thus accounted for in the work before us:—"The difference, amounting sometimes to as much as 200° or 300°, arises from the great resistance which the water meets with, in consequence of the extremely small size of the pipes, and also from the great number of bends, or angles, that of necessity occur, in order to accumulate a sufficient quantity of pipe."

"We shall find," says the author, "that a temperature of 450° produces a pressure of 420 lb. per square inch, while a temperature of 530° makes the pressure 900 lb.; and when it reaches 560°, the pressure is then 1150 lb. per square inch. Those who are acquainted with the working of steam engines are aware that a pressure of 45 to 48 lb. per square inch is considered as the maximum for high pressure boilers; but we see that in this apparatus the pressure varies from ten times to twenty-four times that amount. It will also be borne in mind that, in consequence of the extremely small quantity of water used in these pipes, the slightest increase in the heat of the furnace will cause an immediate increase in the pressure on the whole apparatus. For it appears that if the temperature of the pipes be increased 50° above the amount before stated, the pressure will be raised to 1800 lb. per square inch; and by increasing the temperature 40° more, the pressure will be immediately raised to 2500 lb. per square inch; so that *any accidental circumstance which, causes the furnace to burn more briskly than usual, may, at any moment, increase the pressure to an immense amount.*"

Mr. Perkins seems, in some allusions, to insinuate an impression on his part, that we entertain towards him something like a feeling of hostility. Any impression of the kind is, we can assure him, completely unfounded. He is entirely unknown to us, excepting in connexion with his system. We were required to investigate his apparatus *as we found it*; and, without any personal consideration, we conducted that investigation to the best of our knowledge and ability.

In conclusion, we beg to assure Mr. Perkins, that if he can really render his "system" safe, we shall, on being satisfied as to the fact, be quite as ready to recommend it, as we have been to warn the public of the danger which might arise from its use in the state in which it was when we were called upon to examine it.

Report of William Fairbairn, Esq.

Having directed my attention to the experiments recently conducted by Mr. Davies and Mr. Ryder on this apparatus, I have been induced further to extend my inquiries, and to visit several establishments where Mr. Perkins's system of heating has been introduced. Amongst others I may mention those of Messrs. Schunck, Mylius & Co., Messrs. Novelli & Albanelli, as instances where the apparatus has worked satisfactorily for a number of years, and apparently without risk or danger to the buildings. At both places the parties expressed themselves satisfied with the apparatus, and appeared to have no apprehension beyond the alarm and excitement caused by the late accident at Messrs. Crafts and Stell's.

It is true that reflecting persons, and indeed the whole community, have been seriously apprehensive of danger since that accident took place; and Mr. Davies's report, and the opinion of Mr. Ryder, seem conclusive on that point. In fact, it could not be otherwise, as the practical conclusions deducible from the experiments are clear, namely, the singeing of feathers, explosion of gunpowder, charring of wood, &c., are in themselves sufficient evidence of the risk to which the property of individuals is exposed. It is also apparent, that no system of heating is safe where the water, circulating through pipes of small bore, is raised to a high temperature, and subjected to the changes of increased and sometimes suddenly diminished pressure. On this question, therefore, I have no hesitation in giving it as my opinion, that Mr. Perkins's principle of heating is imperfect, and that more particularly from its liability to be overheated, either by improper treatment or a sudden change of temperature, to which the apparatus is at all times exposed.

Mr. Perkins, in describing his apparatus, replies to these objections by stating that, in order to maintain for any length of time an equal temperature, it is only necessary to proportion the furnace to the time the heat is required to be continued, and the damper will regulate the combustion of the fuel, and the heat of the pipes. By this Mr. Perkins means, that the attachment of his heat regulator or governor, as given in his description of the apparatus, will so regulate the admission of air to the furnace, by the expansion and contraction of the flow-pipe acting upon a series of levers, as to open or close the damper according to the temperature or intensity of heat contained in the flow-pipe. Now I have closely examined this part of the apparatus, and although exceedingly ingenious on the part of the projector, it is nevertheless inefficient in its operation upon the furnace, and cannot therefore be depended upon under all the changes to which the whole series is from time to time subjected. Whether this arises from excess of heat in the coils on the one hand, or from a diminution of temperature on the other, is immaterial, as it appears that the apparatus, as now constructed, is liable, either through neglect or otherwise, to almost all the changes of temperature indicated by the experiments of Mr. Davies and Mr. Ryder.

Mr. Perkins, in his description of the apparatus, gives (Mr. Babbage's experiments) the range of temperature in the flow-pipe and chimney as follows:

	Thermometer on Flow-pipe.	Thermometer in Chimney.
	185°	116°
	225	130
	244	132
	249	176
	249	182
	249	178
	249	180
	249	182
	246	184
	247	146
	235	135
	229	202
Giving a mean temperature during a period of 6 hours of.........................	238	162

Being an exceedingly low temperature, and such as under the regulations prescribed by Mr. Babbage, would be perfectly safe. But comparing the above with the experiments of Mr. Davies and Mr. Ryder, we have the temperature of the flow-pipe equal to that of melted lead, nearly 400 in excess of that which was considered safe by Mr. Babbage. It is clear that in a series of experiments such as those conducted by Mr. Davies and Mr. Ryder, the temperature of the water in the coils and in the flow-pipe, as it issues from the furnace, might be raised to nearly the melting point of iron; but in justice to Mr. Perkins, I am bound to observe, that it is only an experimental case, no doubt carefully and properly conducted, but certainly not indicative of the general working state of the apparatus.

In Mr. Perkins's system of heating there is, I believe, considerable economy, and convenience in its application; it is not, however, the best, nor yet the most wholesome or safe mode of heating. It appears to me to be liable to the following objections:—

1st. The increase of temperature to which the coils and pipes are exposed, and the consequent danger arising from the ignition of flocculent matter, which by accident or neglect might surround the pipes.

2nd. The impurity of the air, caused by its contact with metallic surfaces highly heated.

3rd. Deficient ventilation, where means are not provided for carrying off the impurities, and admitting fresh air at proper intervals.

The above appear to me to be some of the more prominent defects of this system; it is, however, a simple and ingenious apparatus, and provided certain improvements were introduced, I have every reason to believe it might be rendered an agreeable, if not a safe and efficacious mode of heating.

In this country it is obvious that large sums of money have been expended on the use and application of this apparatus; and as numerous buildings, shops, houses, &c., are already fitted with all the necessary furnaces, coils, &c., and as it is impossible to change the apparatus for a better all at once, it appears very desirable to adopt such measures as will prevent the possibility of accident, and afford greater security to property. For these objects I would suggest the attachment of a mercurial tube to the flow-pipes issuing from the furnace, with a metallic piston to rise and fall, and by its action on a throttle-valve damper to check the draught in the furnace, and thus reduce the heat whenever the flow-pipe indicates an excess above the maximum temperature.

Again, I would recommend the flow-pipes to be incased in a perforated iron tube, to a distance sufficient to render a reduction of the temperature certain, and to prevent the possibility of ignition, even when in contact with inflammable matter.

These precautions being adopted, and having encircled the furnace by brick work, I should, under such circumstances, consider the apparatus less objectionable, and freed, in a great measure, from the danger which now surrounds it.

WM. FAIRBAIRN.

Manchester, Apr. 17th, 1841.

ON VENTILATION OF THE COURTS IN THE OLD BAILEY, LONDON.

On the 6th ult. a Court of Aldermen was held for the purpose of receiving a report from the Gaol Committee on the important subject of the ventilation of the courts of the Old Bailey. Dr. Reid was present during the proceedings.

Sir M. Wood brought up the Report of the Committee to whom it had been referred to consider Dr. Reid's plan for improving the ventilations of the courts of the Old Bailey. The committee were of opinion that the plan ought to be adopted. The committee recommended this Court to direct a communication to the Committee for Letting the City Lands, requesting they will present a report to the Court of Common Council, for authority for the work to be preceeded with under their directions accordingly. Sir M. Wood, in conclusion, moved that the Court agree with the Committee in their Report.

The following is the plan, as described officially by Dr. Reid:—

"My Lord and Gentlemen,

"The defective state of the ventilation at the courts in the Old Bailey, which I have examined according to your instructions, arises principally from the following causes;—

"1. The inadequate supply of fresh air.

"2. The imperfect discharge of the vitiated air, a large proportion of which is returned indefinitely upon the person, instead of being removed with certainty and decision.

"The severity of the currents, arising from inadequate diffusion, and the necessary opening of doors and windows from time to time, when complaints are great from the deficiency in the supply of air.

"4. The imperfect nature of various parts of the apparatus in use, which presents different causes that render the air less wholesome and agreeable than it otherwise would be.

"5. The contamination of the small proportion of air supplied to a great extent with vitiated air, more particularly from the hall and other passages. In the kitchen there is a cesspool having no connexion with any drain, into which about 30 pails of water are introduced daily during the sitting of the Courts, all of which appears, so far as I have been able to ascertain, to mingle by evaporation with the atmosphere of the kitchen, and to find its way to the passages.

"It will be obvious that defects such as these cannot be effectually remedied without introducing arrangements of proportionate magnitude, as in the original construction of the courts, it could not be expected, from the period at which they were built, that provision would be made for meeting the views now entertained as to the nature and importance of ventilation; while the chambers below and above both courts, excepting on the roofs of the New Court, are so much occupied that few facilities are presented for diffusive ventilation, by which alone any degree of comfort can be given in places so liable to a fluctuating attendance as these courts must be. Under the circumstances, and proceeding upon the assumption that 2000 persons are as many as it would be necessary to provide air for, according to the replies to the various inquiries upon which I entered in reference to this point, I have to propose the following arrangements. It may be proper for me to premise, however, that 2000 persons 12 hours a day in court require air for 28,800,000 respirations during that period, independent of what may be necessary for the surface of the body:—

"1. Let a chamber be provided for the reception of fresh air where it shall escape much of the contamination which it receives at present from eating-houses, chimnies, &c., in the immediate vicinity.

"2. Let the air be filtered from soot as it enters the chamber, washed, when necessary with lime-water to remove various impurities, and finally be propelled to the courts by a fanner worked by a steam engine. This arrangement appears to be the only economical plan that will insure the ventilation of the courts, considering the peculiarity of their position, and the manner in which they are hemmed in on all sides by different apartments.

"3. Let chambers be provided below each court, that the air may enter diffusively, and as imperceptibly as possible, the diffusion being regulated by perforated zinc or porous cloth at every place represented by the red dotted line in the plan of the courts.

"4. Let a mild hot water apparatus be procured, and let it be arranged in such a manner that by the mere opening or shutting of a valve, it may be made to afford any proportion of warmth, such as the circumstances of the moment may require. I must here remark, that though ventilation may be induced without warming the air before it enters the court, still the two questions are inseparably connected, more especially as in an apartment not ventilated, the vitiated air stagnated around the person produces part of that warmth which ought to be procured from other sources, and which is required to a greater and greater extent, the more freely the air is supplied. To some constitutions the absence of offensive currents, and the supply of air at a proper temperature, are as important as a supply of pure air.

"5. Let the entrance of the air to the court be regulated by a single valve, so that the amount may be proportioned to the state of the external atmosphere and the fluctuating attendance, so that the effect produced upon the person may in all cases be as nearly as possible the same, whatever changes may ensue, either on the attendance at the court or in the external atmosphere.

"6. Let the foul air also be discharged through a single aperture, a valve being provided there also, to be used under particular circumstances.

"7. One external discharge from each court may be provided, but one alone for both would be preferable, but also more costly, from the cuttings required in the roof.

"8. The external discharge should be protected from the action of currents of air by a cowl, or any equivalent modification of the cowl.

"9. The galleries should be supplied with pure air from the fresh air chamber.

"10. A communication should be established between the cesspool in the kitchen and the adjoining drains.

"All the above points are essentially connected with the ventilation of the courts alone, and would cost, as nearly as I can estimate, about 1,925*l.* In stating this sum, it may be proper for me to mention, that a precise estimate cannot be formed, as the precise facilities or difficulties that may be met with in following out the underground cuttings must necessarily modify the result. But I do not consider that there would be a difference of 100*l.*, which might be either less or more than the sum mentioned, according to details that could only be ascertained as the works proceeded. I ought also to observe, that my estimate is founded principally upon the cost of similar works executed in the Queen's Bench and Bail Courts, Westminster, in the Insolvent Debtors' Court, and in various other buildings in London.

"I should not consider the report complete did I not submit for your consideration, that it would be advisable that some minor arrangements should be made for the ventilation of the hall, staircases, and some of the principal apartments in connexion with the courts. In places where the principal room has been ventilated without some attention being paid to lobbies and contiguous apartments, the contrast between the air where ventilation has been introduced and where it has not often leads to complaints that would not otherwise be made, and to the introduction of ventilation in these minor apartments at a future period at a considerable increase of cost. An additional sum of 150*l.* or 200*l.* would enable the ventilation to be greatly improved in all the places now referred to.

"Again, in all buildings constructed in the usual manner there is a defect observed in the movement of air near windows in cold weather, which can be remedied entirely only by double windows; this not being essentially connected with the general arrangements for ventilation, though most important in preventing local discomfort in the seats next the windows, is brought before your notice as a separate question, that can be considered either at present or at a future period.

"Lastly, in making the above report I have to mention, that I have had the advantage of communicating with Mr. Mountague, who has assisted me in obtaining the information required as to the present state of the buildings; and I have the satisfaction to state, that he is of opinion that the several works may be executed without interfering with the character or stability of the building.

"I have the honour to remain, my Lord and Gentlemen.

"Your very obedient servant,

"D. B. Reid."

Sir P. Laurie seconded the motion. He trusted the Court would be unanimous in recommending the adoption of Dr. Reid's plans. It was universally admitted that he had successfully applied them in the ventilation of both Houses of Parliament, an object of paramount importance, which had often been attempted and as often failed. The best evidence that Dr. Reid had been completely successful in his operation on the Houses of Parliament was to be found in the fact that at the conclusion of his labours they had rewarded his talent and perseverance with a complimentary gratuity of 1,000*l.* over and above the stipulated compensation.

The report was confirmed *nem. con.*, so that this complaint will soon be effectually removed.

THE MIASMA OF AFRICA.—NIGER EXPEDITION.

Mr. J. F. Daniell lately read a paper at the Royal Institution, "*On the spontaneous evolution of sulphuretted hydrogen in the waters on the western coast of Africa and elsewhere.*" He commenced by observing, that this subject was now interesting on two accounts—1, because it would recall to the members of that institution the experiments of Sir Humphrey Davy on the subject, and which led him to advise the adoption of ship protectors; and, 2, in consequence of the Niger expedition, fitted out to visit and endeavour to introduce civilization on the western coast of Africa. The effect produced on copper sheathing by the presence of sulphuretted hydrogen in the waters on that coast, was, he premised, well known to every one informed respecting vessels visiting it, and it was a fact that a cruise of nine months on the western coast of Africa injured the copper sheathing of a vessel as much as four years' wear in any other part of the world. The lecturer showed a piece of sheathing taken from the bottom of a Government frigate that had not been many months on the African station, and also a piece from the Royal George, sunk at Spithead, and which had been under water 60 years: the former was eaten through in very many places, and so thin all over that he might push his thumb through it, while the latter was tough and in excellent condition. His attention had been directed to the subject by the Lords of the Admiralty sending him 10 bottles of water, from as many different places on that coast, extending from 8 deg. north of the Equator to 8 deg. south, to analyse, and to report on the component parts thereof, and the accompanying table was the result:—

	Sulphuretted Hydrogen.	Saline Matter.
	Cubic Inches.	Grains.
Sierra Leone, per gallon	6·18	1,696,0
Volta	6·99	2,480,0
Bonny River	1·21	1,788,0
Mooney	..	2,104,0
Gaboon	..	2,169,0
Lobez-bay	11·69	2,576,0
Congo River (Mouth)	0·67	188,0
Congo River (35 miles inland)	..	8,0
Bango	4·35	2,736,0
Lagos	14·75	1,920,0

All the bottles were hermetically sealed, and he had no doubt the water was in every way as good as when taken from the rivers. On drawing the cork, he was immediately struck with the smell of sulphuretted hydrogen, and adopted the general idea that it arose from animal and vegetable decomposition, but it had since appeared to him that such was not entirely the case. The gas extended a distance of 15 or 16 deg., and in some places as far as 40 miles to sea, covering therefore a space of 40,000 square miles. Now what could the origin be? He thought that it arose from the action and reaction of vegetable and animal matter brought from the interior of the rivers upon the sulphates in the sea water. With this idea he gathered last autumn some leaves from a shrubbery and put them into three jars; into one of which he poured some plain New River water, into the second some of the same water in which three ounces of common salt had been dissolved, and into the third the like water, in which some crystallized sulphate of soda was dissolved. To the covers of the jars he fixed inside some litmus paper, and placed them in a cupboard, the temperature of which varied from 70 to 100 or 110 deg. The effect was, that in the first the litmus paper was perfectly white, and the smell by no means unpleasant; in the second the paper was quite white, and the smell similar to that of a preserve; but in the third jar, in which a sulphate was present, the paper was nearly black, and the stench was horrible and nauseous in the extreme, as every one knew the smell of sulphuretted hydrogen gas to be. Now sea-water contained sufficient sulphates to produce this effect, under peculiar circumstances. But a more interesting part of the subject was the miasma so injurious to life on the marshy shore of Western Africa. Some persons said that if science cannot point out a remedy, it is useless to investigate the causes, but he did not so think; if science could not point out a remedy, still it could point to something as a palliation of the evil. The presence of the injurious gas was easily tested by the roughest hand, so that places in which it abounded could be avoided; and if imperative duty rendered it absolutely necessary to go to those places, then plentiful fumigations of chlorine gas would effectually destroy the sulphuretted hydrogen. The effect of this gas was not only visible on the Western coast of Africa, but in many places elsewhere, although not to so great an extent. Might not the jungle fever of India, the periodical fevers of New York and Charleston in America, and the minor diseases on the coast of Essex, be traced to the effects of this deleterious gas? It was a well known fact that the ships in the mouth of the Medway consumed more copper than other ships. Chlorine gas then destroyed the injurious gas, and it was easily made, and the materials very cheap; the Government had plentifully supplied the African Expedition with the materials necessary for the most perfect chlorine fumigations, and he had the pleasure of believing that his report founded on the analysis of the waters submitted to him, and the precautions taken, had imparted confidence not only to the gallant men who composed that expedition, but also to those who had interested themselves in its welfare.

SEVERN NAVIGATION IMPROVEMENT.

(Concluded from page 247.)

Abstract of the Evidence on behalf of the Worcester and Birmingham Canal Company against the Bill for improving the Severn, given before the Committee of the House of Commons on the Bill, May 17, 18, 21, 24, 25, 27, & 28, 1841.

Mr. P. Giles, engineer, examined by Mr. Austin.—I am a civil engineer, and have surveyed many rivers, harbours, canals, and railways. I am acquainted with the Thames, Mersey, Medway, Ayr, and Calder, and many other rivers; I have also planned the construction of works with reference to the Severn; I have surveyed the Severn with reference to the navigation; I then particularly directed my attention to the drainage and scour of the river, as far as they were compatible with the navigation; I surveyed the river in 1837 with Mr. Rhodes' plans; I have surveyed it partially in the present year. I am acquainted with the plan of Mr. Cubitt. Mr. Rhodes' plan was for a ship canal up to Worcester, and a barge canal up to Stourport. [Witness then described Mr. Rhodes' plan. That plan was not carried into execution. I have heard the whole of the evidence on the present plans. My objections to it beginning at Stourport are to the proposed solid dams; I object to the principle of damming a river permanently. With reference to this river, it will decidedly obstruct the drainage, and be a great bar to the navigation, when there is sufficient depth of water to pass; and I think a different kind of weir could be constructed that would afford the means of passage in low-water season. In the first place, a solid dam must necessarily raise the summer water level to the height of the dam; when the flood is above the summer water level, supposing it to commence as the summer water is now, not impounded (but you can pound it five, six, or seven feet) supposing the flood to commence rising above the artificial sum, if in the first place the flood rises five feet or more above the original summer water, it must rise it also five feet above the artificial sum of water, and so on every flood it must increase with the rise of the flood in the same degree that the summer water is to the flood.

By Mr. Barneby.—My answer does not refer to the river when bank full, but of course it would fill sooner.

By Mr. Austin.—This plan would affect some of the existing drains, particularly that which is made in the sewer at Worcester, and the drainage up the country from the Salwarp to Ombersley. The drainage is about eighteen inches above the low summer water, and of course the dam at Upton must raise the water permanently in proportion to its height, and thus in flood affect the drainage; and that is not all, for the drainage of the gross matter which comes from the sewers of large towns would be collected in pools, which I think would be a very important matter. The Bevere Island dam in like manner would affect the drainage of the Salwarp; for if the water was penned up below the Salwarp, it would be penned up in the Salwarp too. The Salwarp drains an important district, which would consequently be affected. In my opinion, if oblique weirs would pass more water than straight ones, which I do not think they will, it would not the less affect the drainage of the district. Whether oblique or at right angles the permanent height would be the same, and from that I apprehend the effect to the drainage. The deposit would silt upon the upper side of the weir; and I understand this to be the effect at the weirs on the Ayr and Calder, where they have flood-gates which would assist to remove the deposit. I would have the weirs so constructed as to have two, three, or more flood-gates, sixty feet wide, so as to be open whenever freshes come down; I believe this would have a good effect upon the drainage. With any weir there must be a lateral lock, but when the weir was open there would be no necessity for using the lock. I can form but one opinion of the mode in which it is proposed to construct the weirs—and that is, that they must wash away. I have never built one myself but with solid masonry, and with a puddle bank to back it; I believe a footing is absolutely necessary. I don't hesitate to say that it would be most advisable to dispense with weirs between Gloucester and Worcester; I certainly think the experiment should be tried. I would put a weir above Worcester, at the upper end of the pool, opposite the "Dog and Duck;" I would dredge up to this point, through the bridge at Worcester. I think also the dam at Bevere Island should be at the Salwarp. This would render it necessary to sink the soil at Diglis lock, nothing more. The channel-dredging in the river would necessarily lower the water at the wharfs at Worcester, and it would therefore be necessary to dredge up to the wharfs also; this would improve the drainage at Worcester. It would be necessary to have a dam at Worcester bridge, and to underpin the piers. I think the improvements below Worcester should be executed, according to the exigencies of the case, as they presented themselves during the undertaking. I would first proceed to narrow the river to a certain channel in the soft parts by groins, the points of which would form one grooved channel down the river. I should be able to ascertain the force of the scour as the works proceeded, and thus to regulate the extent to which I would apply the operation of dredging. I should dredge at once in the hard shoals with an inclination of four feet to one; I would propose to dredge six feet for the purpose of obtaining five. I should not let my groins run into the river to the full extent at first, but should add to them, if I found it necessary to do so, to maintain the depth. Deerhurst shoal being wholly composed of sand, it would be an interminable task to attempt dredging alone, but with the assistance of the jetties or groins, I think the scour of the river would maintain the depth required. I think Mr. Provis' mode of throwing in stones for the foundation of his side walls a very bad one. I propose in forming my groins to use stakes of larch, lined in the usual way with faggots. My groins will generally be about 120 yards apart. The quantity to be dredged I estimate at 500,000 cubic yards, which, at 1s. per yard, would come to £25,000; the groins I estimate at £28,500; and I have put down £6,000 to be spent upon Worcester Bridge, but I think that is much more than will be required, for I believe £1,000 for each pier will be quite sufficient. Then I have set down £10,000 for contingencies (which is more than 10 per cent.) so we will take the total cost, in round numbers, at £70,000. I was employed by the Worcester and Birmingham Canal Company to form a plan of my own for improving the Severn; this was after Mr. Rhodes' plan had been given up. My plan went before Parliament, but it did not pass.

Cross-examined by Mr. Serjeant Merewether.—I cannot tell you the height of the weir in my plan for improving the Severn, but it was up to high water mark. I have this morning had a model brought here, at the request of an hon. member made to me yesterday, but I should like to speak with Mr. Austin before I produce it. [Here a question arose whether the model should or should not be produced. Previous to the termination of the conversation, it was understood that the Committee would re-examine Mr. Cubitt towards the close of the investigation, to hear his answer to the objections which had been made against his plan.] This plan was suggested by me to the Worcester and Birmingham Canal Company, who paid for the surveys and application to Parliament, and who intended to have carried out the improvement by a commission. The toll was to be 2*d*. per ton from Diglis to Gloucester. I have proposed another plan for the improvement, where the toll to be paid was 1*s*. per ton, but that was for a Company, and not in connexion with the Birmingham Canal Company. It was brought forward in opposition to Mr. Rhodes' plan, and when that plan dropped my plan also dropped. I agree with Mr. Walker's regret—as expressed in his report—that so little has been done towards the improvement of the Severn. I do not think that Mr. Cubitt has sufficiently considered the drainage in his plan. I know the situation of Lord Sandys' drain. I went down last Friday night to open it and examine its level, and I knew the drain before. This drain is about 100 yards above Holt Fleet Bridge. The sewer at Worcester, which I mentioned yesterday, has been lately constructed, and I particularly mentioned it because it is the principal one in the city. I was told the fall of that sewer by the person who built it. I am only acquainted with the outfall of that drain. I do not believe the fall is 25 feet. The bottom of the outfall of this drain is 18 in. or 2 ft. above the present low summer level of the Severn, and the sewer is perhaps 5 ft. in height.

By Mr. Godson.—The basin in Lowesmoor is at least 20 feet above the low summer level of the Severn.

Cross-examination continued: I have no doubt but that there is a great fall in that drain. I should think the entrance of the drain may be 20 feet above its outfall. I have not heard of any public meeting of the people of Worcester, in alarm at the effect of the improvement on this sewer, but I have seen a gentleman on the subject. It was Mr. Williams, of the Distillery. He resides on the opposite side of the river to where this sewer enters. Where the water, in consequence of these artificial ponds, stops up the mouths of drains, it must impede the drainage. I do not know the particular effect it may have upon this sewer, because I do not know the fall, but the silt will have a tendency to collect at the mouth, and will certainly be deposited at the foot of the weir. The banks are about 16 or 17 feet above the sewer at Worcester. There is not a considerable fall on the Salwarp a short distance from its mouth; there is only a fall of a few inches about a quarter of a mile up the river. The height of the banks of the Severn near the mouth of the Salwarp is about 15 or 16 feet. I do not know the fall a quarter of a mile further up where the mill is situate. I still say that the valley of the Salwarp would be flooded sooner in consequence of the weir at Bevere Island than it otherwise would be. I have never seen weirs constructed as Mr. Cubitt proposes to construct his, but I still think that his weirs would not stand. Though I know Mr. Cubitt well, and know him to be a man of great experience in these matters, I have no hesitation in saying that I believe him to be wrong in the construction of his weirs, both in the mode of forming them and the material to be employed (red sandstone from Holt and its neighbourhood). I never heard of such a weir giving way, because I never heard of such a weir being constructed. I do not believe that Mr. Cubitt's weir will be water-tight, for I do not think the sheet-piling will be water-tight; and I do think that the water leaping over the sheet piling will blow up the stone-work. I think a single row of sheet piles will not be water-tight. I have never seen a weir on the Tail, and I do not know that there is one there constructed by Mr. Cubitt.

By Mr. Hastie.—I have seen the weir at Hampton Court, but it is not applicable to those proposed to be constructed on the Severn, as it is formed of strong piles, having sluice-boards, and I will undertake to say that it has a solid foundation, either of timber or masonry.

Cross-examination continued.—The placing of rubble stone as an apron in front of the sheet-piling will strengthen the weir, if the piling be water-tight. I shall construct my groins with a slight inclination downwards. My groins will be formed of willow stakes wattled; they will be triangular, the base being against the back of the river, and the apex running into the stream. It is a very old mode of forming groins, and groins constructed in this manner were formerly in the Severn at Upton and near the Ketch. They were removed as a nuisance, because they canted the stream to one side. I mean to construct my groins so as to preserve a continuous channel as much as possible. I have certainly no doubt but that longitudinal walls would get a more perfectly continuous channel than the use of groins, if they could be perfectly formed, which I think could not be the case by dropping in the stones, as proposed by Mr. Cubitt. No doubt it would be a great evil for a boat to strike the point of one of my groins. I do not approve of Mr. Cubitt's proposal to take advantage of the deepest parts of the channel, but prefer dredging a straight channel along the centre of the river. There are five arches at Worcester Bridge, and the centre one is 42 feet wide. The total ascent I have by my plan from Gloucester to Worcester race-course is 6 ft. 4 in. The deepest water is under the centre arch and the one to the left. When the water is low, I do not think there is more than 3 feet under the centre arch. I shall first dredge three arches, then a channel 60 feet wide, through the shoal up the race-course, and subsequently dredge up to the wharfs. When I have dredged through the arches and shoal, I should think all the water will be drawn from the wharfs, as it generally is at present. I have been employed for years by the Worcester and Birmingham Canal Company. I do not know that, in consequence of the boats not being able to unload at the Worcester quays, from want of water, they go into the Birmingham canal to unload. I have not calculated the amount nor the cost of the dredging along the quays. [illegible] allowed enough in the £10.000 for contingencies, and in the £6.000 for the bridge. I should think the quays would require under-pinning in consequence of the dredging, but I think the parties connected with them will find it their interest to do it themselves, as the quays are very different to interfering with the bridge, which of course it would be my duty to protect from injury. The surface of the water at the quays will be lowered 5 feet. There will be 19 or 20 feet from the surface of the water, after the bottom has been dredged, to the top of the quays. Below the bridge, there is the wall of the Bishop's Palace, and the Cathedral is not far from the edge of the river; dredging would have the effect of undermining these structures if it were carried close up to them.

Re-examined by Mr. Spooner.—The model I have exhibited does not apply to any part of my plan below Worcester. The groins will be about 50 feet long, by 10 feet wide at the head, and 25 feet at the base or abutment, and packed inside the faggots with hard clay. The channel will not be dredged up to the wall of the Bishop's Palace, but merely in the middle of the river. I am still of opinion, notwithstanding the five hours' cross-examination, that I could successfully dredge up to the Dog and Duck.

By Mr. Barneby.—I do not think the weirs on the Thames are at all applicable to those proposed to be put on the Severn.

Mr Giles examined by Mr. Lowndes.—There is a lower drain on Lord Sandys' property which is not stated in the section. I have had it opened at various points, and it applies to the under springs. I should say that the outfall of this under drain will be 18 inches below the crown of the pen of water formed by Mr. Cubitt's weir at Bevere Island. The fall of this drain in the first 200 yards is 4 feet If the present outfall were raised, it would lose the full force which at present exists there. I think the dam at Bevere Island will affect the drainage; about 100 acres of good land are drained by this under drain. The dam at Holt Fleet will affect the drainage of the surrounding land there, which is also very good land. My plan would only raise the level at Salwarp and at Holt one foot, instead of upwards of 4 feet, which it would be raised by Mr. Cubitt's scheme. I see no difficulty in the way of dredging quite up to Holt, and thus have no weir below that point. I think the weirs below Worcester will not only have the effect of affecting the drainage, but also prevent the foul air escaping from the sewers, which would be a great nuisance to the city. The towing paths in the neighbourhood of Lord Sandys' property are very bad. I know of none in such bad condition. I think any plan which would place the river under the control of one body and the towing paths under another must be bad. This inconvenience could be avoided

Cross-examined by Mr. Serjeant Merewether.—I knew the under drain before, but I did not open it till Saturday. In stating that this drain will be 18 inches under Mr. Cubitt's level, I stated on the supposition that there would be 6 inches water on the crown of his weir above the drain. I think that a crust would form in the mouth of the drain, because the floods bring down clay and slime which soon harden.

Mr. W. C. Milne then gave evidence in favour of dredging, which closed the case of the Worcester and Birmingham Canal Company.

Evidence on behalf of the Gloucester Canal Company, and the Corporation of Gloucester.

Mr. Walker examined by Mr. Sergeant Wrangham.—I am a civil engineer of long standing. I was employed to build the Haw Bridge on the Severn 12 or 14 years ago. I also surveyed the river in 1836, and reported upon Mr. Rhodes' plan to the then Severn Navigation Company, by whose chairman, J. W. Lea. Esq., I was employed. I was requested in March last by the Berkeley and Gloucester Canal Company to give my opinion upon Mr. Cubitt's plan. I differ very little with respect to that plan from Mr. Cubitt, up to Upton Ham, except in the details. As we differ so much as to the mode of improving the river above Upton, I should state that Mr. Cubitt proceeds upon the same principle between Gloucester and Upton. I think the river might be made navigable up to Diglis without weirs; and I think it would be a pity to introduce them into so fine a river. My great objection to a lock below Diglis, is, that it would be unnecessary and expensive. I see no reason why the fall from Diglis to Upton could not be practically maintained, as well as the fall below. I do not know any objection to dredging above Upton on account of the hardness of the shoals. It is on account of their hardness they are there, and were they removed the scour of the river would keep the channel clear. If locks and weirs are placed in the Severn, and prove inefficient, I think the matter deposited would be so great in quantity (as in fact the bottom of the river would be then at the top of the weir) that it would be a work of more labour to remove it than to remove the weirs themselves. The shoals formed by the weirs would be greater than the present shoals, but I do not say they would proportionally obstruct the navigation, because the trade will pass through lateral cuts. I am supposing that the bed of the river is formed of gravel and similar substances, which would be washed down in a flood. This in the course of time would have to be removed from the mouth of the cuts by the dredging machine, or else the cuts must be carried further above the weirs. The river below is capable of taking more water than could pass over the oblique weirs, which would consequently be an obstruction. I heard the evidence given in reference to these weirs with great surprise. The only advantage of oblique weirs over others is when little water is coming down, when there would be a thinner sheet of water over the oblique weir than there would be over a cross one, but in a sharp fresh the water would flow over, parallel with the banks, and the oblique weir would not be more advantageous than another. In some instances the oblique weir has an advantage over the direct one, but it is not of more advantage in preventing floods, and I think they would not be so convenient for shooting boats over them in flood time. I think boats would have a greater tendency to capsize over an oblique weir than over a direct one. The expense of my plan up to Diglis would be, including contingencies, £66.000. The cost of maintenance would not be so much as in the plan of Mr. Cubitt; except the lock and weir at Upton, there is not much difference in the expense of our respective plans, so far as Diglis. I see no engineering difficulty in placing the lock at Diglis above the entrance to the Birmingham canal. There is no reason why there should not be steamers up to Worcester all the way from Bristol, so that Worcester may become a little Glasgow. On the Clyde steamers are employed not only to convey passengers, but also to tow up fleets of vessels carrying merchandize. I see no great difficulty in dredging through Worcester Bridge, the only question is the amount of work necessary to secure the foundations, but I think it would be advisable to place the weir a little below the bridge, that there might be an extensive pool opposite the city. On the whole I agree with Mr. Cubitt's plan so far as relates to that part of the river between Worcester and Gloucester, with the exception of the solid weirs. In point of fact, if we had an opportunity of consulting together, I think that as repects the whole line there would be little difference between us.

Mr. Walker cross-examined by Mr. Sergeant Merewether.—Were I the friend of Worcester, I should endeavour to prevent six feet being the maximum depth of the improvement of the river. I have taken a great many soundings, but no borings. I think Worcester bridge cannot be built upon a shoal; there is deep water under the arches, and the shoal is below the bridge I did not say wherever there is dredging there should be walling, but wherever the material is soft it should be walled; but this is not the case above Upton. If the slope of the rubble stone facing is 1½ to 1, it requires packing; but a slope of 3 to 1 would not require packing. I do not know that the Deerhurst shoal has increased: I do not know whether the gravel which is marked in the first section is natural to the place, or has been brought there. The support of each side of the gateway of my weirs would be brace piling. The rest of the river would be occupied by standards about 16 feet apart, and level at least with the top of the proposed weirs, which weirs again would be level with the top of the penned water. There is no reason why the gates should not be raised by machinery, but they are not so in the Thames. If the parties waited till a flood came they could not be moved, and in such case there would be no advantage over the solid weirs. I have seen the Teddington gates partly opened. I think the weeds floating down the stream might have a tendency to fill up the gates. I have made no estimate of the expense of this sort of weir, nor of the expense of attending to or repairing it. I think all the frame-work might be taken out at the beginning of the winter, and put in again about April. While I entertain the opinions that I do at present respecting the improvement of the Severn, I shall always prefer open weirs. No human art can altogether prevent the necessity of dredging in the river. I think a basin at Worcester would be a very desirable thing.

Re-examined by Mr. Sergeant Wrangham.—Since I was examined on Thursday I have carefully re-perused Mr. Cubitt's evidence; and the opinions I then expressed respecting it are strengthened by my having done so. It would be very easy to pick out the weeds from the gates and timbers, much more so than to dredge the deposit at a solid weir. According to my doctrine, if none of the shutters of my weirs could be removed before the flood came, the obstructions would not be greater than by the solid weirs. My weir would cost more *per se* than Mr. Cubitt's; but if you include the dredging that would be required at Mr. Cubitt's weir, mine would be much the cheapest. I think a lock below Worcester would be a great disadvantage to the future navigation to that city; but if it were constructed on my principle I think that inconvenience would be proportionally diminished.

By Sir W. Rae.—The additional expense of dredging by my plan from Upton to Diglis would be £10.640; the expense of walling 4½ miles would be £10,000. I take the whole expense at £25.000 up to Diglis; and there would be £4,600 additional for dredging up to Worcester; £1,600 for walling, and £2.000 for dredging opposite the quays.

By Mr. Barneby.—There would be as much dredging above Worcester bridge if my plan was put in execution.

By Viscount Ingestrie.—The gates of the weir would be ordinarily raised by hand by a person in a boat; I dare say it would take three hours from beginning to end to raise them.

By Mr. Bailey.—The obstruction by a solid weir is 7 times 16, or 112; the obstruction by the open weir would be about one-third of this. There would be no danger in short water of not being able to keep sufficient water for the navigation in consequence of the leakings. I give my plan simply as a general idea; I did not expect to be examined so closely respecting it.

By the Hon. R. Clive.—My honest opinion is that dredging should be first tried for the improvement of the river; if that should fail, a weir of some kind should be tried; but I think they would be the worst friends of the navigation of the river who would recommend the construction of the weirs in the first instance. I think, as I said in my report, it would be very important to try of what the river is capable without locks and weirs.

By an Hon. Member.—There is more tide in the Clyde than in the Severn. The shoals in the Severn would be more difficult to remove than the soft stuff now in the Clyde; but there were originally hard shoals in that river.

By Mr. Godson.—The sum about to be expended upon the Clyde is about half a million. I can't tell what has been expended. Whether the improvement I propose would be worth a shilling a ton to the trade is out of my department to answer; but I think all the trade would be benefitted by it. The Severn will never become so large a navigable river as the Clyde, because the tide does not so much assist it; but I have no doubt it will become a fine river one day. The resistance on any given amount of an oblique weir would be less than on a direct one, but on the whole sum it would be the same. I have seen Mr. Giles's model of a weir. I think there is a complexity about it that should be avoided; it would also be expensive. I don't think walls would be required on both sides the river; two might be injurious. At the time Mr. Smeaton made his survey of the Clyde the shoals were much worse than they are in the Severn.

By Mr. Pryme.—I do not know what the piers at Worcester Bridge are, but I should think the dredging under it could not affect the safety of the bridge.

By Mr. Barneby.—It may be necessary to remove the shoal in the Avon in consequence of the dredging below Upton. Every weir makes as it were a step in the river; and if you remove it, it would be necessary also to remove the deposit that would be accumulated.

Mr. John Timperley, formerly resident engineer of the Ayr and Calder Navigation, was then called to prove that in that Navigation the oblique weirs were of no advantage, and that dredging to a great extent was still necessary, and was now carried on at a considerable expense. The only portion of his evidence relating to the matter before the Committee was the following:—I do not agree with Mr. Cubitt that in floods the water will pass off just as freely as if his oblique weirs were not in the river at all—it is impossible. I do not think Mr. Cubitt's weirs will be nearly strong enough. I have seen a vessel washed over the top of the dam on the Ayr and Calder, and it was not a very unusual occurrence, as they could not always stop the boat; the rope might slip or break, and then the boat would go over the dam. I have not examined the Severn, but from what I have heard, I have no doubt the river might be improved up to Worcester without weirs. If weirs are used they should not be solid.

Cross-examined by Mr. Talbot.—I only know personally about the Severn, from having once driven over the Haw Bridge. There are many mills on the Ayr. The weirs were originally put in to keep up the water for the mills. There are dam boards in these weirs, and if there is a heavy fresh it is difficult to remove them. They require repairing sometimes. The Calder is a tortuous river.

Re-examined by Mr. Wortley.—The Calder is a tortuous river, but the Ayr is not.

By Mr Godson.—The water at the highest floods goes straight over the weir, but it goes at right angles when it is a moderate stream; at six or seven inches water it goes at right angles, but at six or seven feet it goes over straight. I agree with Mr. Walker that it is possible, after dredging up to Worcester to the depth of six feet, further to improve the river so that ships might come up. I do not know the exact depth of the Gloucester & Berkeley Canal.

By Captain Winnington.—I believe that the Ayr and Calder Navigation is not wider above the oblique weirs than at any other part.

Mr. Fulljames, examined by Mr. Wood. I am an architect and engineer, and am surveyor to the county of Gloucester. I have erected a bridge over the Isis, superintended the removal of the old Over Bridge, and have put up large flood-gates on the Severn six miles above Gloucester, &c. I have been employed by the landowners between Worcester and Gloucester to oppose this measure, and have made observations accordingly. There are about 20,000 acres between Worcester and Gloucester under flood water-mark, (or the level of the banks) and the parties employing me own about half that quantity. I have been used to the Severn all my life, and from observations made during the last ten or fifteen years, I find that, on an average, there is one summer flood in five years, three land floods per annum, and three winter floods in two years. Summer floods are wholly injurious, and so are back water or land floods, but the winter floods are sometimes useful, inasmuch as they deposit a sediment which is beneficial. In 1839 the whole crop of hay on this extent of land was either carried away or destroyed. The loss was about 3*l.* per acre, and nearly the whole tract is grass land. I believe that the weir at Upton would cause a flood to overflow these low lands for miles, which would not rise above the banks if there were no weir there. [Here the witness stated, in answer to various questions, that he entirely agreed with Mr. Walker's evidence, and on Mr. Pryme informing Mr. Wood that the weir at Upton was abandoned, he turned his attention to the improvement as effected by dredging up to Diglis.] I do not approve of Mr. Cubitt's mode of dredging, because he does not take the centre of the stream, as proposed by Mr. Walker; by dredging near the banks they would be liable to slip in. I do not approve of the mode of forming the side walls, because there would not be enough stuff to fill up the space between the walls and the banks. I should not recommend the landowners to assent to Mr. Cubitt's plan of dredging up to Diglis, supposing that the weir was not put in at Upton. Mr. Fulljames was further examined, but his evidence mainly coincided with that of Mr. Walker.

Cross-examined by Mr. Craig.—The 10,000 acres I spoke of are subject to floods. I think about 200 of them belong to Mr. Hyett. They are about ten miles from the proposed weir at Upton Ham. Part of them are 1½ mile from the Severn. About 600 acres belong to Mr. Fulljames, a near relation of mine. About 158 acres belong to Mr. Yorke. They are all below flood mark, and are 5 miles below the proposed weir. The witness was examined at considerable length, but his evidence was merely a repetition of what has been already published in that of other witnesses. In answer to questions by Sir W. Rae he said:—By doing away with the weir at Upton, steam tugs could come up to Diglis. Vessels tugged by a steamer would require three men for general purposes. Steam boats have been tried on the river, but were discontinued for want of water.

Mr. Cubitt was recalled by the Committee, and confirmed his former evidence. In answer to questions by Mr. Bailey, he said—I am not aware of the length of the drains of Worcester nor of the fall.—(Mr Bailey then stated the dimension and fall.) I do not think, if such is the dimension and fall, our works will affect it. I think covering up the mouth of the drain would be beneficial rather than otherwise, as it would prevent the effluvia from reaching the city. It is possible to widen the river to so great a width and to put in a weir across it at so great a length that it shall be able to take the whole water of the river at summer time or flood time; therefore, assuming I make a weir of great length across the bed of the river, and widen out the river to admit free access to the weir, and make the weir so long that six inches of water along the weir should be of a sectional area equal to the whole of the river, of the same height above and below the weir; and it must be evident to those who think about it, that there is as much water way at the height of two feet six inches as in any cross section of the river above or below, at any dead level. It is, therefore, possible to make a weir which shall be an obstruction to a certain height, and after that height shall be no obstruction. The merit of the weir consists not in its obliquity but its length. (Mr. Cubitt then produced a model to show the amount of obstruction that would be occasioned by the weirs, the details of which he explained to the Committee.) He also said that he could [illegible] oblique [illegible] which would not affect the stream at all: others might say it could not be effected, but it was a fact which could not be affected by their statements. I could produce a model in which water could pass over a weir, but I have an objection to do so, since they never act well on any scale. I have heard dredging down the centre of the stream mentioned as preferable to my plan; my only objection to it would be its expense; I kept expense constantly in view in my arrangement. I said in my cross-examination that it was feasible to dredge up to Worcester. We could sooner build a lock and weir at Upton than we could dredge from Upton to Worcester: dredging would take one season more. It does not appear to me that there is any material objection to that plan being followed. It would be impracticable to dredge from Worcester to Stourport: millions might do it, but hundreds of thousands would not: it would be quite out of question to dredge to the Dog and Duck on account of the fall. With six feet navigation over the lock sills, vessels from 80 to 120 tons could come up from the sea, through the Gloucester and Berkeley Canal, up to Worcester and Stourport; steam boats could pass through the locks without difficulty. If the bill passed I should be content to confine myself to one lock and weir this winter, and in the spring I would commence the others together. I think it would be best to commence below Worcester; I would engage to get the Diglis lock completed before Christmas. Suppose the bill passed, omitting the Upton weir, I would put all the lower Severn in a fit state for dredging by that time. I would finish the Diglis lock and weir at the same time; and I would be content that further operation should depend upon the effect of those works.

By Mr. Lowndes.—I admit the level near Lord Sandys's drain may be raised 18 inches.

Mr. Cubitt and Mr. Giles then entered into mutual discussion and explanation as to the effect of the works upon the drainage at Holtfleet and the Salwarp, when it appeared that in consequence of the section being very small, Mr. Giles had supposed the line representing the level formed by the Bevere Island weir to be horizontal, whereas in fact it sloped one inch per mile.

The Committee came to the following resolution.—

"That the preamble of the Bill is proved;" and then proceeded to consider the Bill clause by clause. The Bill was ultimately postponed until next Session, in consequence of the early conclusion of the Session.

REVIEWS.

The True Principles of Pointed or Christian Architecture: set forth in Two Lectures, delivered at St. Marie's, Oscott. By A. WELBY PUGIN, Architect and Professor of Ecclesiastical Antiquities in that College. Small 4to. London: J. Weale, 1841.

That this new work of Mr. Welby Pugin's will excite much interest, both among his professional brethren, and amateurs, may be confidently pronounced by us beforehand, since whatever comes from him must command attention; but that it will please every one is more than we dare assert; or rather we are certain that a good deal in it will prove unpalateable to a good many folks. By not a few, this volume—and a very handsome and tasteful volume it is—will be opened with anxious misgivings and apprehensions for themselves and their productions, since Mr. Pugin is known to be a tolerably plain-spoken man, and if anything rather overstrict than at all lax in his critical opinions. He is not one of those who keep beating about the bush, who fearful of giving offence, or of being thought too severe, rather hint at than utter what may be unpalateable truths. On the contrary, he gives free utterance to what he thinks, and he both thinks and speaks to the purpose; consequently what he does say must on that very account be all the more provoking to those who would be exceedingly glad to be able to gainsay not a little that his book contains.

Among the malcontents will be those who have been taught, or who teach others to look upon *classical* architecture, as the very perfection of the art—as its culminating point both in taste and genius, and who even consider it to be the highest merit of us moderns to be able to transplant a portico from a Grecian or Roman temple. The following extract will at once convince our readers, that Mr. Pugin will scandalize those whose orthodoxy is of the above kind.

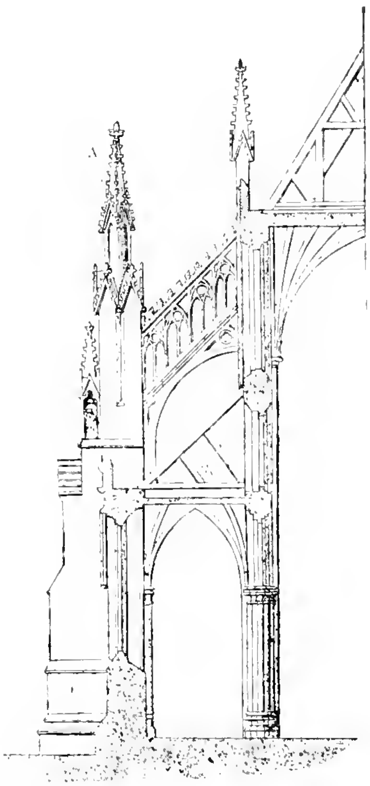
Grecian architecture is essentially *wooden* in its construction; it originated in wooden buildings, and never did its professors possess either sufficient imagination or skill to conceive any departure from the original type. Vitruvius shows that their buildings were formerly composed of trunks of trees, with lintels or brestsummers laid across the top, and rafters again resting on them. This is at once the most ancient and barbarous mode of building that can be imagined; it is heavy, and, as I before said, essentially wooden; but is it not extraordinary that when the Greeks commenced building in stone, the *properties of this material did not suggest to them some different and improved mode of construction?* Such, however, was not the case; they set up stone pillars as they had set up trunks of wood; they laid stone lintels as they had laid wood ones, *flat across;* they even made the construction appear still more similar to wood, by carving triglyphs, which are merely a representation of the beam ends. The finest temple of the Greeks is constructed on the *same principle* as a large wooden cabin. As illustrations of history they are extremely valuable; but as for their being held up as the standard of architectural excellence, and the types from which our present buildings are to be formed, it is a monstrous absurdity, which has originated in the blind admiration of modern times for every thing Pagan, to the prejudice and overthrow of Christian art and propriety.

The Greeks erected their columns, like the uprights of Stonehenge, just so far apart that the blocks *they laid on them would not break by their own weight.* The Christian architects, on the contrary, during the *dark ages*, with stone scarcely larger than ordinary bricks, threw their lofty vaults from slender pillars across a vast intermediate space, and that at an amazing height, where they had every difficulty of lateral pressure to contend with. This leads me to speak of buttresses, a distinguishing feature of Pointed Architecture, and the first we shall consider in detail.

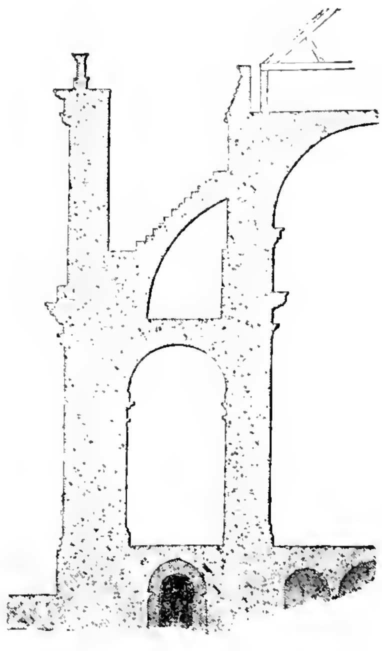
It need hardly be remarked that buttresses are necessary supports to a lofty wall. A wall of three feet in thickness, with buttresses projecting three feet more at intervals, is much stronger than a wall of six feet thick without buttresses. A long unbroken mass of building without light and shade is monotonous and unsightly; it is evident, therefore, that both for strength and beauty, breaks or projections are necessary in architecture. We will now examine in which style, Christian or Pagan, these have been most successfully carried out. Pointed architecture does *not conceal her construction, but beautifies it:* classic architecture seeks to conceal instead of decorating it, and therefore has resorted to the use of engaged columns as breaks for strength and effect;—nothing can be worse. A column is an architectural member which should only be employed when a superincumbent weight is required to be sustained *without the obstruction of a solid wall;* but the moment a wall is built, the *necessity and propriety of columns cease*, and engaged columns always produce the effect of having once been detached, and the intermediate spaces blocked up afterwards.

A buttress in pointed architecture at once shows its purpose, and diminishes naturally as it rises and has less to resist. An engaged column, on the contrary, is overhung by a cornice. A buttress, by means of water tables, can be made to project such a distance as to produce a fine effect of light and shade. An engaged column can never project far on account of the cornice, and all the other members, necessarily according with the diameter of the column, would be increased beyond all proportion. I will now leave you to judge in which style the real intention of a buttress is best carried out.

I have yet to speak of flying buttresses, those bold arches, as their name implies, by which the lateral thrust of the nave groining is thrown over the aisles and transferred to the massive lower buttresses. Here again we see the true principles of Christian architecture, by the conversion of an essential support of the building into a light and elegant decoration. Who can stand among the airy arches of Amiens, Cologne, Chartres, Beauvais, or Westminster, and not be filled with admiration at the mechanical skill and beautiful combination of form which are united in their construction? But, say the modern critics, they are only props, and a bungling contrivance. Let us examine this. Are the revived pagan buildings constructed with such superior skill as to dispense with these supports? By no means; the clumsy vaults of St. Paul's, London, mere coffered semi-arches, without ribs or intersections, *have their flying buttresses; but as this style of architecture does not admit of the great principle of decorating utility*, these buttresses, instead of being made *ornamental, are concealed by an enormous screen*, going entirely round *the building. So that in fact one half of the edifice is built to conceal the other.*



Section of a Pointed Church, with the Flying Buttresses decorated.



Section of St. Paul's, London, a Church built in the revived Pagan style, with the Flying Buttresses concealed by a Screen.

Although we will not go so far as to say it is inconsistent with correct principles of taste to introduce columns merely for the sake of decoration,—a doctrine which if consistently and strictly followed up, would put us out of conceit with the ornamental parts of many Gothic structures also;—we certainly do agree with Mr. Pugin in the main. Beautiful as we consider Grecian architecture to be as regards its mere forms, we have always felt it to be exceedingly *borné* and limited in expression. The whole of it lies in a very narrow compass; it admits of scarcely any combinations; it may, in fact be said to be stereotype. Like a barrel-organ it can play only a single set of tunes, which however agreeable they may be at first, become tiresome by repetition. Antiquarian travellers visit Lycia and other parts of Asia Minor, and merely return with *mare's-nest* discoveries of what we may find just as well, in our own libraries and portfolios; or if they do chance to meet with something like a new idea for a column or capital, scarcely ever is it turned to account, but we go on with our hackneyed Ilissus Ionic, &c., *usque ad nauseam.*—But we are now *improving* upon Mr. Pugin, so let us cut short our own remarks, and return to him and his book.

As it will, doubtless, be ere long in the hands of most of our readers, who will then have the advantage of the numerous illustrations as well as the whole of the text, we shall not attempt to follow its author step by step; therefore, passing over many clever original remarks in regard to 'mouldings,' and the 'use of the splayed form,' &c., we shall notice his free animadversions on the preposterous absurdities passed off by fashionable upholsterers, cabinet-makers, and paper-hangers as

Gothic furniture and Gothic patterns, in the true Brummagem gusto; illustrating some of these mongrel monsters by specimens in his engravings and cuts,—among the rest, of a "New Sheffield pattern for a modern *Castellated Grate!*"

"Modern grates," he observes, "are not unfrequently made to represent diminutive fronts of castellated or ecclesiastical buildings with turrets, loopholes, windows, and doorways, all in a space of forty inches.

"The fender is a sort of embattled parapet, with a lodge-gate at each end; the end of the poker is a sharp pointed finial; and at the summit of the tongs is a saint. It is impossible to enumerate half the absurdities of modern metal-workers; but all these proceed from the false notion of *disguising* instead of *beautifying* articles of utility. How many objects of ordinary use are rendered monstrous and ridiculous simply because the artist, instead of seeking the *most convenient form*, and *then decorating it*, has embodied some extravagance *to conceal the real purpose for which the article has been made!* If a clock is required, it is not unusual to cast a Roman warrior in a flying chariot, round one of the wheels of which, on close inspection, the hours may be descried; or the whole front of a cathedral church reduced to a few inches in height, with the clock-face occupying the position of a magnificent rose window. Surely the inventor of this patent clock-case could never have reflected that according to the scale on which the edifice was reduced, his clock would be about two hundred feet in circumference, and that such a monster of a dial would crush the proportions of almost any building that could be raised. But this is nothing when compared to what we see continually produced from those inexhaustible mines of bad taste, Birmingham and Sheffield: staircase turrets for inkstands, monumental crosses for light-shades, gable ends hung on handles for door-porters,(?) and four doorways and a cluster of pillars to support a French lamp; while a pair of *pinnacles* supporting an arch is called a Gothic-pattern scraper, and a wiry compound of quatrefoils and fan tracery an abbey garden seat. Neither relative scale, form, purpose, nor unity of style, is ever considered by those who design these abominations; if they only introduce a quatrefoil or an acute arch, be the outline and style of the article ever so modern and debased, it is at once denominated and sold as Gothic.

"While I am on this topic it may not be amiss to mention some other absurdities which may not be out of place, although they do not belong to metal-work. I will commence with what are termed Gothic-pattern papers, for hanging walls, where a wretched caricature of a pointed building is repeated from the skirting to the cornice in glorious confusion,—door over pinnacle, and pinnacle over door. This is a great favourite with hotel and tavern keepers. Again, those papers which are shaded are defective in principle; for, as a paper is hung round a room, the ornament must frequently be shadowed on the light side.

"The variety of these miserable patterns is quite surprising; and as the expense of cutting a block for a bad figure is equal if not greater than for a good one, there is not the shadow of an excuse for their continual reproduction. A moment's reflection must show the extreme absurdity of *repeating a perspective* over a large surface with some hundred different points of sight: a panel or wall may be enriched and decorated at pleasure, but it should always be treated in a consistent manner."

These cavalier censures will hardly obtain for Mr. Pugin the good-word of the honourable company of Paper-Stainers and Paper-Daubers. It may reduce the value of their stock on hand, and also of that of the Sheffield and Brummagem artists, at least 75 per cent.; but let them and Messieurs the upholsterers plaister up their pique with the comfortable reflection that, as many people will now be ashamed of their trumpery *Gothicizings*, and proceed to get rid of them as fast as they can, they must have their rooms refurnished,—which will, of course, be all for the benefit of trade.

In his second lecture he again touches upon the subject of furniture, and has another slap at the Upholsterers; who

"Seem to think that nothing can be Gothic unless it is found in some church. Hence your modern man designs a sofa or occasional table from details culled out of Britton's Cathedrals, and all the ordinary articles of furniture, which require to be simple and convenient, are made not only very expensive but very uneasy. We find diminutive flying buttresses about an arm chair; every thing is crocketed with angular projections, innumerable mitres, sharp ornaments, and turreted extremities. A man who remains any length of time in a modern Gothic room, and escapes without being wounded by some of its minutiæ, may consider himself extremely fortunate. There are often as many pinnacles and gablets about a pier-glass frame as are to be found in an ordinary church, and not unfrequently the whole canopy of a tomb has been transferred for the purpose, as at Strawberry Hill. I have perpetrated many of these enormities in the furniture I designed some years ago for Windsor Castle. At that time I had not the least idea of the principles I am now explaining; all my knowledge of Pointed Architecture was confined to a tolerably good notion of details in the abstract; but these I employed with so little judgment or propriety, that, although the parts were correct and exceedingly well executed, collectively they appeared a complete burlesque of pointed design."

This last confession is highly creditable to Mr. Pugin. Such a frank avowal of his own artistical delinquencies, speaks much in his favour, and shows that if he is severe towards others, he cannot be reproached with being over-indulgent towards himself. At the same time we must say that if the censures he levels against architects and their employers be for the most part well merited, they are occasionally too sweeping and overstrained. His objections, for instance, against the application of the Italian style, to domestic architecture in this country, amount to little more than a sophistical tirade. "What," he asks, "does an Italian house do in England?" Which question put forth by him as an unanswerable one, might be turned against the cause he himself advocates; for just as well might it be asked, on the other hand, why should a house erected in the reign of Queen Victoria, be made to resemble one built in the time of Edward IV., or, Henry VII. or VIII? Why should a Protestant church of the 19th century be in any respect modelled like a Roman Catholic one of the 14th or 15th? Is not the Italian style to the full as applicable to our actual wants and purposes in the majority of cases, as any mode *borrowed*—for borrowed after all it must be—from examples to be found, indeed, in our own country, but belonging to periods more dissimilar from, than in aught resembling the present one? Nominally Italian as to design, are not Barry's two Club-houses in Pall Mall, perfectly English in their accommodation? We could easily extend this list of questions; but until they are answered they will answer for the present occasion. Even our ancestors themselves were addicted to change: they endeavoured to make their buildings keep pace with the progress of social improvement and the spirit of the times. Nay, *mutatis mutandis*, what Mr. Pugin himself urges against the castellated style might in some degree be objected to some other styles of much later date.

"What can be more absurd than houses built in what is termed the castellated style? Castellated architecture originated in the wants consequent on a certain state of society: of course the necessity of great strength, and the means of defence suited to the military tactics of the day, dictated to the builders of ancient castles the most appropriate style for their construction. Viewed as historical monuments, they are of surprising interest, but as models for our imitation they are worse than useless. What absurdities, what anomalies, what utter contradictions do not the builders of modern castles perpetrate! How many portcullises which will not lower down, and drawbridges which will not draw up!—how many loop-holes in turrets so small that the most diminutive sweep could not ascend them!—On one side of the house machicolated parapets, embrasures, bastions, and all the show of strong defence, and round the corner of the building a conservatory leading to the principal rooms, through which a whole company of horsemen might penetrate at one smash into the very heart of the mansion!—for who would hammer against nailed portals when he could kick his way through the green-house? In buildings of this sort, so far from the turrets being erected for any particular purpose, it is difficult to assign any destination to them after they are erected, and those which are not made into *chimneys* seldom get other occupants than the rooks. But the exterior is not the least inconsistent portion of the edifices, for we find guard-rooms without either weapons or guards; sally-ports, out of which nobody passes but the servants, and where a military man never did go out; donjon keeps, which are nothing but drawing-rooms, boudoirs, and elegant apartments; watch-towers, where the housemaids sleep, and a bastion in which the butler cleans his plate: all is a mere mask, and the whole building an ill-conceived lie."

We would give a trifle to know what is Mr. Pugin's opinion of Windsor Castle;—in fact we should very much like to see a volume of comments from his pen relative to some of the principal modern Gothic structures he has examined in various parts of the country. We do not imagine that he is perfectly satisfied with any one of them —not even with Windsor itself; still, they cannot all be equally bad: some must possess more or less merit in particular parts, or else be conspicuous for egregious sins and defects; and at any rate, we should then obtain something in the shape of specific criticism from Mr. Pugin, instead of those generalized observations to which he has hitherto chiefly confined himself. In the meanwhile, we thank him for the present work, from which much profitable instruction is to be obtained. Considerable praise is also due to the publisher, for the truly elegant manner in which the volume is got up, so as to render it one well fitted not only for the library, but the drawing-room and boudoir; nor is it deficient in the popular recommendation of being unusually cheap.

History of Belvoir Castle, from the Norman Conquest to the Nineteenth Century; with a Description of the Present Castle, and Critical Notices, and the Paintings, &c. &c. By the Rev. Irvin Eller, of Queen's College, Cambridge. 8vo. London, 1841.

We shall confine ourselves to the latter half of this volume, namely, the description of the Castle itself and its apartments, as being that which more properly comes under our cognizance, and which is most to our individual taste. From the first or historical part we content ourselves with gathering the following notices in respect to the building. After being wantonly laid in ruins by Lord Hastings, on whom it had been bestowed by Edward IV., the Castle was begun to be rebuilt in the reign of Henry VIII, by Thomas, first Earl of Rutland, and was completed by Henry, the second Earl, about 1555. It was afterwards dismantled by the Parliamentary forces under Cromwell, and again rebuilt in 1668. Excepting some slight alterations, such as the addition of a picture gallery, made by George, the third Duke of Rutland, about 1750, the structure underwent little change until the beginning of the present century, when the new works were commenced in 1801, and carried on under the direction of Wyatt till 1816, at which time the south-west and south-east fronts were completed, and the grand staircase and picture gallery in the north-west one nearly finished. On October 26th of that year a most calamitous fire broke out,* which consumed the whole of the north-west and north-east sides, and would probably have extended its ravages further, had it not been arrested by bricking up the doorway opening from the grand staircase into the Regent's gallery, which, with the chapel, form the south-west front of this extensive pile. Of the pictures destroyed we have here a complete catalogue, with the sums at which each was valued—varying from 5*l.* to 3000 guineas—and those for which each was insured. Among them were a great many family portraits by Sir Joshua Reynolds, and his large picture of the Nativity, painted for the centre compartment of the stained glass window in New College, Oxford.

After this event the north-east and north-west fronts were rebuilt under the direction of the Rev. Sir John Thoroton,† an amateur architect, who appears to have greatly improved upon the ideas of his professional predecessor, notwithstanding that the latter was no other than the "celebrated" Wyatt. One very material improvement on the original plan, both as regards external appearance, convenience, and internal effect, adopted by Sir John—is the grand entrance in the north-west front, consisting of a spacious advanced carriage porch, connected with the building by a short corridor forming an approach to the vestibule or "guard-room;" whereas, previously to the fire, there was nothing, whatever of the kind—no sheltered intermediate space, but visitors entered immediately from the open air into the vestibule.

"It would be tame language," says Mr. E., "to speak of the present entrance (merely) as an improvement. Nothing can be in better taste than the porch with its lofty doors, its pointed arches, its ogee-shaped canopies with finials, and the cloister-like entrance." "The porch, entrance-passage, guard-room and gallery, were all designed by Sir John Thoroton from portions of Lincoln cathedral. The entrance-passage is lighted by eight windows (four on each side), between which shafts rising from flowered corbels, form the support of moulded ribs on the vaulted roof."

Judging from the plans, we should imagine there must be a striking degree of effect in the view through the arch facing the entrance, into what is called the Guard-room Gallery, formed by a screen of arches on a higher level, it being in fact the first landing, off from which lies the grand staircase. For want, however, of more exact explanation, and of either view or section, it is difficult to comprehend so clearly as we could wish to do, what, owing to the difference of levels, is rather a complex and intricate part of the interior. We may, therefore, express our regret that none of our graphic "Illustrators" and view-makers, should have thought proper to satisfy our curiosity relative to Belvoir. The most that any of them, we believe, have done, is to give us one or two general views of the Castle, but from such points as rather to exhibit its locality, the general character of the structure, and the various masses of building composing it—as seen rising above the lofty trees embosoming it—than to show what its architectural design really is. This is the case with the view (the north-east front), which serves as the frontispiece to the present volume. Greatly do we desiderate a distinct architectural view of the entrance and corridor connecting it with the building; as likewise of another representing that portion of the south-west front which forms the exterior of the chapel, and which is spoken of as being of "purely perpendicular character."

"It has some good features about it," continues the writer, "especially in the parapet above the arcade in the basement story, which formed no part of the original design by Wyatt, but was added by Sir John Thoroton, in imitation of a portion of the parapet in Lincoln Cathedral. The windows are of elegant proportions, and harmonize well with the general character and intention of the building. We might, perhaps, have wished that the embattled parapet of the two towers had been of a rather less gossamer character, and that more substantiality had been imparted to the pinnacles. But, upon the whole, the architecture of the chapel forms an exquisite break upon the general plainness of this part of the Castle. It comes upon the view so unexpectedly, and contrasts as effectually with the remainder of this front, as the little cultivated spots which we meet with in the surrounding scenery, when, after passing through the dense foliage of gigantic trees, we suddenly arrive at an open area, where the tasteful skill of the floriculturist has been at work."

We return again to the interior; but, referring to the work itself for descriptions of the several apartments, and of the paintings and other works of art they contain, shall merely enumerate some of the principal rooms, adding their respective dimensions. From the upper landing of the grand staircase, any of the following rooms may be immediately entered. The Picture Gallery (over the Guard-room gallery, and the ascent to it), the Regent's rooms (over the Guard-room or Vestibule), the Regent's gallery, an Ante or Waiting-room, beyond which is the principal library.

Picture Gallery 61.10′×25.8′ and 31.5′ high, lighted from above by a series of windows fitted with ground glass.
Regent's Rooms.—Sitting-room 24.6′×20.9′.
Bed-room 24.6′×18.
Dressing-room 21×17.9′.
Regent's Gallery, 131×17.8′, or, including the semi-circular bay, (35.9′ in diameter, and containing five windows) 35.8′. Height 18.2′. The folding doors at the S. W. end open into the tribune of the chapel.
Ante-room, 30.4′×21.6′ with a single window towards the inner court, but lighted principally by a lantern in the ceiling.
Library, 47×23.9′ and 18 high; with four windows on the side towards the inner court.
Grand Corridor, extreme length including the staircase on that side of the building, 120×24. Though called a corridor, the proportions and dimensions of this thoroughfare room entitle it just as well to the name of Gallery; and it is in fact occasionally used as a ball-room.
Green or Assembling Room, 27×24, and 17.6′ high.
Chinese Rooms: Setting Room 29×22.
Bed Room 26×17.
Dressing-room 26×17.
Elizabeth Saloon, 55×36, and 20.10′ high.
Grand Dining-room, 55×31, and 19 high. Five recesses, viz. one at each end, and three on the side opposite the windows, with two fire-places between them.
Hunters' Dining Room, 21×17.
Family Dining Room, 34×21.

This last is one of the suite of private apartments in the S. E. front; above which is another suite, occupied by the late Duchess: the principal one, a boudoir, 22.4′×19.6′, exclusive of the oriel window, which adds 6·3′ more to the length of the room, and which commands a most delightful prospect, where "the eye, passing over the foliage on the terraces immediately below the Castle, is refreshed by a beautiful expanse of water, immediately beyond which is rising ground covered with plantations. The village of Woodthorp, in the valley, a little to the left, with the spire of its simple church, is sufficiently distinct to form a sweet feature in this scene of rural repose. At a more remote distance, the magnificent mansion of Mr. Gregory (at Harlaxton), forms a terminal point for the eye to rest upon near the horizon of the landscape."

Here we must take leave of Belvoir—not because little more remains to be spoken of, for we have not even mentioned one principal

* How the fire originated, could, it seems, never be discovered—probably because those who could have cleared up the mystery chose to keep their own counsel. For some piquant remarks on the subject of such "accidents," we may refer our readers to an article in the last No. of the Polytechnic Journal, entitled the British Museum and its Library," where the writer indulges in some pleasantry on the *pyrophobia*—the excessive horror of fires and candles exhibited by the managers of that national institution—which is such that it induces them to close the reading rooms very long before sunset, during several months in the year.

If not as a preventive against fire, at least as a means of checking its progress, we would suggest that in all very extensive residences, particularly where the entire pile consists of distinct masses and parts, there should be exceedingl thick internal party walls between the different ranges of rooms, so that the fire could not spread beyond that portion of the plan where it might happen to break out. Were this done, not only would there be comparatively little danger, but also less alarm and confusion in case of fire, as the inmates would feel themselves in safety in other parts of the building.

† This gentleman, who was rector of Bottesford, adjoining Belvoir, from 1782 to 1820, (in which year he died at Belvoir Castle, Dec. 18th, in his 62nd year,) and who was knighted by George IV. when Regent, deserves to rank high among those who have cultivated the study of architecture. "One half of the present Castle," says Mr Eller, "and certainly *the most beautiful portion* in an architectural point of view, was erected chiefly from his designs and under his superintendence."

object of attraction to visitors, namely the Mausoleum, of which, and also of Bottesford Church and its monuments, long descriptions are here given: but we do so because we have already bestowed as much notice on Mr. Eller's book as our limits will permit. It has afforded us considerable gratification, and we would suggest, for his consideration, whether it would not be desirable to republish the description of the castle, &c., separately in a duodecimo volume, omitting altogether the biographical notices of artists in the account of the pictures: which being done, there would be opportunity for entering into some particulars that are now either passed over or but slightly touched upon. It would be a further improvement were the terraces to be shown in the ground floor plan of the building

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Graphic Illustrations with Historical and Descriptive Accounts of Toddington, Gloucestershire, the seat of Lord Sudeley. By John Britton, F.S.A. Publisher, the Author, 1840.

By this work, containing twenty-three external and internal views, and nine lithographed plates of details, Mr. Britton has sought to make known to the public one of those modern adaptations of the pointed style to private dwelling houses, the excellence of which he has by his earlier works so mainly assisted to bring about. The energy with which Mr. Britton for more than five and forty years, has continued to superintend the illustration of our ancient buildings, and to direct public attention to their beauties, affords an example well worthy of imitation, and must entitle him to the warm applause of the right minded.

Lord Sudeley, the owner and the designer of the new mansion at Toddington, formed one of the Committee (as Mr. Hanbury Tracy,*) appointed to select from the numerous designs sent in competition for the new Houses of Parliament, and devoted much time and zeal to the investigation. The building under consideration which has occupied his Lordship's attention more than twenty years, proves fully that he was well qualified for the task, having an intimate knowledge of architecture as a fine art. The construction of a modern mansion in the style of buildings of the middle ages is not an undertaking of trifling difficulty. "By a judicious attention to appropriate models," says Mr. Willson in his preface to Pugin's specimens, "a modern residence of whatever size, may be constructed in the Gothic style without departing from sound principles of taste. Some modifications of ancient precedents must be allowed, for an absolute fidelity will frequently prove incompatible with convenience; but as few deviations as possible should be gone into; and above all, nothing should be attempted which is inconsistent with the character and situation of the place, or which cannot be executed on a proper scale of dimensions." This feeling is evident throughout Toddington, and has led to a very successful result, redounding to the credit of its designer the more highly because of the difficulty. Attached to the account of the house is a short essay on the comparative merits and eligibility of the Grecian, Roman, and Monastic or Gothic architecture for the purposes of the modern English mansion, wherein the author traces lightly the progress of architecture in England, and refers to those men who have chiefly aided this progress. In this essay Mr. Britton observes, "of the manner in which architects were employed soon after the Reformation, the household accounts of Henry VIII. furnish some curious but deplorable information. From these it appears that painters, sculptors, carvers, and *architects*, were retained at stipulated periodical wages. Holbein, John of Padua, Lawrence Bradshaw, Richard Lea, and some others were thus engaged; and they designed several of the mansions which were then erected, and which are now more admired in the picturesque drawings and engravings of the artist, than as comfortable residences for the noble or wealthy families of this age. So the châteaux of the old noblesse of France, and the castles of the Edwardian dynasties of England, are picturesque and imposing objects in the landscape, but have few charms or attractions to render them endurable as permanent homes for persons who wish to enjoy domestic quietude and comfort."

For Walpole's advocacy of Gothic architecture, although ill exemplified by him at Strawberry Hill, Mr. Britton gives his tribute of praise, and then describes some few of the better sort of dwellings more recently erected in England in this style.

Want of space however prevents us at this moment saying anything more of the work in question, than that it is a very valuable and acceptable addition to the scanty stock of books which we at present possess on domestic architecture.

* Mr. Tracy was raised to the peerage July 12, 1838.

Illustrations of Windsor Castle. By the late Sir Jeffry Wyatville, R.A. London: Weale, 1841.

This is a folio work in two volumes, on a scale of magnificence but rarely seen, the size of the plates corresponding to the beauty of their execution. These plates are six and twenty in number, besides wood engravings, some of them too containing more than one view, and embracing nearly every part of the external architecture of the Castle and Stables, besides plans of the Castle in its former state. These engravings are executed in a manner so costly as only the devotion of an architect to his favourite subject could authorize, being quite beyond the usual limits of publishing enterprize. The letterpress being printed on paper of the same dimensions, makes the volume rather unwieldly as a readable book, which is to be regretted as the valuable matter contained in its pages is such as to excite great interest. The general superintendence has been confided to Mr. Henry Ashton, and the literary portion by him again transferred to Mr. Poynter, than whom few could be found better qualified. The editors having determined upon excluding a description of the interior of the edifice on account of so much of its decoration being not merely of a passing interest, but adopted against the will of the architect, necessarily restricted themselves to a mere antiquarian description of the Castle. To this task Mr. Poynter has brought a depth of research, which has added much that is new to our previous knowledge of the subject, and given a degree of certainty to many points which before were involved in obscurity. The result of these labours may not be great, but the extent of research required is easily to be appreciated. To transfer to our pages any thing like a complete history of the Castle would be of course impossible, but we cannot allow this volume to pass us without gleaning in some way from its pages.

In the reign of Edward the Third, called the Confessor, we find the earliest authentic notice of Windsor, when it was granted by that last reigning sovereign of the Saxon kingly race to the Abbey of Westminster, under the name of Wyndleshore, a grant which by William the Norman was resumed by an exchange for some lands in Essex. This prince erected a castle at Windsor, which is registered in Domesday Book. At Old Windsor, however, the Saxon kings are believed to have had a palace at an early period. In the reign of Henry III., the castle was rebuilt, and from this period begins to date its historical renown, being in the next reign considered second in importance only to the Tower of London. A few architectural fragments brought to light during the progress of the improvements, are supposed to be the only relics of this edifice. Henry III. made great improvements in the lower ward, and the traces of his work are to be recognized in the present day, during the whole of his reign indeed extensive buildings were in progress. Of the chapel built by this prince, Mr. Poynter is of opinion that a doorway may be recognized behind the altar of St. Georges. In two years the large sum of 873*l.* was allotted to the works. The Belltower the editor attributes to the 25th year of Henry's reign, and to the Garter Tower he is inclined to assign the same date. It is to be observed that during this reign we find frequent provision for chimneys and glass windows; it seems also that the erection of temporary wooden dwellings within the Castle was not uncommon. In searching out the particulars of the works of Henry III., Mr. Poynter has made a very diligent investigation of the Pope and Close Rolls and other records, which have enabled him to employ a minuteness of description equally interesting to the antiquarian and to the architect. Of how much value researches of this nature may become we see when we come to consider how they bear upon any restoration of the western extremity of the Castle.

The next great epoch in the history of the Castle is the reign of Edward III., a period respecting which we have ample information. The foundation of the College and restoration of St. George's Chapel was the first step taken by this monarch, which was succeeded by the inauguration of the Order of the Garter. In 1356, the celebrated William of Wykeham was appointed surveyor, and the works proceeded with great vigour, and in 1359 three hundred and sixty masons were pressed for the service of the castle, and in 1362 on account of a pestilence three hundred and two more. In the first half of 1363 as much as 3802*l.* 17*s.* 8*d.* was paid for the works including 932*l.* for lead, and thirty-six glaziers were impressed, twenty-four to serve in London, and twelve at Windsor. More masons were also impressed. In 1364 the whole expenditure was 3031*l.* 9*s.* 9*d.* In 1365 a payment occurs of 13*l.* 6*s.* 8*d.* to John, a canon of St. Catharine's, the king's picture painter, for a picture with images for the chapel, and another of 50*l.* to John de Lyndesay, for a table with figures also for the chapel. It is to be remarked that then as during the reign of Henry III., the artists appear to have been generally ecclesiastics, dignitaries of the church combining the practice of the arts with their clerical functions. In 1366, 600*l.* was paid for lead, and the whole expenditure was 4976*l.*

9s. 9d. To William de Burdon, the king's painter, was paid 13l. 7s. for a great tablet for the altar. In each of the years 1367 and 1368, the expenditure was about 2000l. To William de Burdon was paid 20l. more for his picture for the chapel, 10l. was paid for buying marble, 60l. for German copper for bells, and the very large sum of 200l. for a great alabaster table for the high altar of St. George's. This according to the largest estimate would be 6000l. of the present money. After 1369 no more workmen were impressed, and in a few years the expenditure was gradually diminished; the last payment being in 1374. In this reign from a payment of 50l. for a new bell for it, a clock seems to have been placed in the bell-tower, as has been the practice down to the present day. Of the early works of Edward III. a portion is the Dean's cloister, of other works the outlines are scarcely to be traced, although he added to the castle the upper ward. Here however is yet to be seen the principal gate adjoining the keep. In the interior of the castle the work of Edward III. is still visible in the vaulted basement of the Devil Tower. The arches of this vaulting are four centered, and present an early specimen of the systematic use of that form. By Edward III. most of the buildings of Henry I. were pulled down, and the Keep is supposed to have been rebuilt.

Under Richard II. in 1390, the appointment of Clerk of the Works was for a short time held by Geffrey Chaucer, the Father of Modern English Poetry, his salary being 2s. a day, with the power of appointing a deputy. Under Henry VI. the revenues of Windsor amounted to 207l. 17s. 5¼d., a sum far from sufficient to meet the expenses; the manors of Cookham, Bray, Binfield and Sunninghill were farther charged with 100 marks per annum for the repairs.

By Edward IV. the existing Collegiate Chapel of St. George was built, the direction of the works being confided to Richard Beauchamp, Bishop of Salisbury, a most distinguished prelate and architect. In 1480 the expenditure was 1408l. 16s. 9¼d. The principal part of the stone came from Tainton in Oxfordshire, where Henry Jennings the master mason purchased 9755 feet at 2d. per foot; the carriage by land through Burford and Culham to Henley cost 151l. 12s., and it was thence conveyed by water to Windsor bridge. Some portion of Caen stone was also used, and Heath stone from Cranbourne Chase. The timber came principally from Upton, Ashridge, Farnham, Wyke and Sunninghill, and the carriage of these materials and of sand and lime amounted to 29l. 10s. 3½d. The cost of scaffolding and other plant, tools, smith's bellows, tiles and tilepins for workmen's sheds, withes to tie scaffolding, straw, candles, seacoal, charcoal, steel, iron for the windows, iron bolts for the carts, sheet iron, tin, tin pans, nails, &c. amounted to 141l. 8s. 1d., and the workmen's wages to 555l. 6s. 1½d. For these works masons were impressed, and the best workmen were so monopolized by the king for St. George's, that other works were sadly impeded, as was the case with the Divinity School at Oxford. Carving seems now to have become a secular employment, and a large sum was appropriated for this class of work, being in this year 75l. 4s. 6d. With the Chapel the Chapter House was also rebuilt. In 1481 stone was obtained from Caen, Tainton, Sherborne, Ryegate, Milton and Little Daryngton, and the expenditure for the year 1249l. 18s. 5d., being for stone 137l. 5s., for carriage 349l. 18s. 0½d., for other materials and stores 144l. 11s. 11½d., and for wages 457l. 10s. 6½d., including 62l. 12s. 6d. for carving. The next year the expenditure was 1145l. 7s. 2¾d., of which for carving 100l. 10s. 4d.; and in 1483 960l. 12s. 10d., of which 186l. 10s. 4d. for carving. Thus in four years out of a total expenditure of 4674l. 15s. 3d., 425l. 7s. 8d. was paid for wood carving. In 1483 Edward IV. was buried here, behind a curious screen of iron work, an elaborate piece of workmanship, generally thought to be of foreign manufacture, but by the editor assigned to John Tresilian, the master smith. Among the benefactions of Bishop Beauchamp to the Chapel, was the following exertion of the influence in its favour. John Shorne or Schorne was a pious rector of Northmarston in Bucks, about the year 1290, and held in great veneration for the virtues which his benediction had imparted to a holy well in his parish, and for his miracles, one of which, the feat of conjuring the devil into a boot, was considered so remarkable, that it was represented in the east window of his church. Bishop Beauchamp obtained a license from the Pope to remove the shrine of John Shorne from Northmarston wherever he pleased, and he accordingly removed it to the Lincoln Chapel at Windsor. At the Reformation, the College of St. George's lost 500l. per annum from the offerings at this shrine. In 1481 Bishop Beauchamp was succeeded by Sir Reginald Bray. Richard III., the last of the Plantagenets, during the first year of his reign appropriated 733l. 10s. 9¾d. for the building of the College and Chapel. In 1484 the body of Henry VI. was removed from Chertsey and buried in the Chapel.

Henry VII. left his personal property and the profits of his lands for the completion of the new works in the body of the Chapel. During his reign the works were directed by Sir Reginald Bray, who built the Bray Chapel, now the South Transept. In 1508 the roof of the Choir was constructed in stone, the expense being supplied by a subscription of the Knights of the Garter. The main vaulting is by the editor cited as without exception the most beautiful specimen of the Gothic stone roof in existence. Henry VII. took down the original chapel of Henry III., for the purpose of building a royal mausoleum in its room, but the work was not completed. The shell of the building is supposed to be of his reign. In 1500 the Deanery was rebuilt by Doctor Christopher Urswick; the houses of the Minor Canons are also attributed to this reign. A lofty oriel in the upper ward and the inclosure of the stairs to the Keep may be assigned to the same date. By a typographical error in the work before us, the death of Henry VII. is assigned to 1503 instead of 1509. The principal work of Henry VIII. was the great gateway of the lower ward of the Castle. In 1528 the exquisite fan groining of the roof at the interstices of the Cross of the Chapel was executed by subscription of the Order of the Garter. Wolsey began a stately tomb at Windsor in the chapel erected by Henry VII. hence named Wolsey's Tomb House. On this work he employed Benedetto, a Florentine artist, who began it in 1524, and to him were paid 4250 ducats, and 380l. 13s. for gilding. These works were destroyed by some of the Parliamentary troops in 1646 for the sake of the metal, except a sarcophagus of black marble of Italian design, which in 1805 was placed over the tomb of Nelson in the crypt of St. Paul's. In 1519 James Denton, one of the canons, founded the building called the New Commons, now incorporated with the Prebendal Houses, but of which a doorway is preserved, richly ornamented. Under Edward VI. in 1537, the fan vaultings of the side aisles to the choir were executed, and works begun for bringing a supply of water to the Castle from Blackmore Park near Winkfield, a distance of five miles. To supply the pipes, Wallingford Castle and other ancient buildings were stripped of their lead, 370 cwt. from Maidstone. Under Queen Mary in 1555 the pipe was brought up into the middle of the Upper Court of the Castle, "and there the water plenteously did rise 13 foot high." In this place was formed a reservoir from which every part of the Castle was supplied. In this reign the houses of the military knights were completed, having been begun in the third year of Philip and Mary, and finished in three years at an expense of 2747l. 7s. 6d. The Square Tower and some portion of the structure to the east were previously standing, and the additions and alterations were made with materials taken from other buildings. The stone was brought from Reading Abbey, and eighteen fothers of lead, and "twenty old apparails for chimneys," from Suffolk Place in Southwark. To Elizabeth Windsor Castle is indebted for its terrace, although some parts of it appear to have been in existence previously, every ten feet of the terrace wall, twenty feet in height, and six feet at the base gradually sloping to six feet at the top, costing 125l. 16s. 8d. In 1570 1900l. was expended on a thorough repair of the Chapel, supposed to be the private Chapel adjoining St. George's Hall. A general repair of the Castle was made by this Queen, which in the six years ending 1575 had amounted to 6600l. In 1576 Queen Elizabeth's Gallery was built, it now forms a portion of the Library. In the seven years ending 1577 the works had cost 7800l. In the report on the works in 1580, a clause, relating to the apartments of the Maids of Honour, recites that these ladies "desire to have their chamber ceiled, and the partition, that is of boards there, to be made higher, for that the servants look over." In this reign for the first time we have a connected description of the Castle by Paul Hentzner, a German traveller who visited England in 1598. He says that in the Castle he was shown among other things the horn of a unicorn, eight spans and a half in length, and valued at 10,000l.

Under James I. was executed the survey of the Parks and Forest by John Norden, which contains the first view of the Castle. By an entry in the Issue Roll for 1607, it appears that this survey was presented to the King by its author, who was rewarded with a gift of two hundred pounds. Nothing it is said was done at Windsor under Charles I. until 1635, when several alterations were made. It was the intention of Charles I. to convert the Tomb-house into a place of sepulture for his family, but this plan was not carried out. On the deposition of Charles I., Captain Fogg, an officer of the Parliament, and subsequently, Colonel Venn, under orders from the Commonwealth, carried off the plate and decorations of the Chapel and ruined the painted windows. In the reign of Oliver Cromwell many repairs were made, and the revenues of the Castle greatly improved. This prince also attached to the Chapel the foundation of the Military Knights, for whom Sir Francis Crane's building was erected. Under Charles II. a complete alteration of the Castle was made by Sir John Denham and Sir Christopher Wren, and the best artists were employed upon the paintings and carvings of the interior, in which a profusion of the exquisite works of Grinling Gibbon still exist. Charles's principal addition to the Castle was the Star Building, now called the Stuart Building, about one hundred and seventy feet long. Verrio was employed on the allegorical paintings, for which he was to receive a sum of above seven thousand pounds in five years; in 1701, however, 20 years after, 1800*l*. was still due to him. In 1674 St. George's Hall was fitted up as a theatre, and French plays performed in it. In 1675 the North Terrace was enlarged to its present extent. Wren's alterations of the exterior of the Castle were far from improvements, for he left it with a most unpicturesque appearance which it retained for above a century. In 1680 the equestrian statue of Charles II. was erected by Tobias Rustat, Yeoman of the Robes. It is the work of Josias Ibach Strada of Bremen, but the sculptures on the pedestal are attributed to Grinling Gibbons. In this reign was commenced the Long Walk. James II. fitted up the Tomb House as a Catholic Chapel, which Verrio was employed in decorating. William III. contemplated great improvements, and employed Wren to draw a plan in the Italian style, which is inserted in the work under our consideration; nothing however was done. Under Queen Anne Sir James Thornhill was employed in painting the Great Staircase, and in the first eight years 40,000*l*. were laid out in repairs. The extraordinary works were principally confined to the Parks.

The two first Hanoverian kings merely kept the Castle in repair, George the 2nd however employed William Kent at an expense of 400*l*. in restoring some of the paintings. George III. erected the detached edifice opposite the South Terrace, called the Queen's Lodge, which was completed in 1782 at an expense of nearly 44,000*l*., and is said by the editor to have been executed from the plans of His Majesty, "whose taste for practical architecture is well known." It was removed in 1823 by George IV. In 1787 Mr. Emlyn was employed to restore the interior of St. George's Chapel, at the private expense of George III In 1796 the painted glass window in the Chapel was completed by Jarvis and Forest, from the designs of West. In 1796 James Wyatt was appointed Surveyor General, who effected many improvements. In 1810 the design of establishing a royal sepulchre was carried into effect, and a vault constructed under the Tomb House. George IV. having decided upon extending the Castle as an imperial residence, obtained a preliminary grant of 300,000*l*. from parliament, and appointed Mr. Jeffry Wyatt to the superintendence of the works, who in 1828 received from the monarch the honour of knighthood, by the title of Sir Jeffry Wyatville. The cost of the whole of Sir Jeffry's works was 771,000*l*., and they included the following works, new, rebuilt, or thoroughly repaired, New St. George's Gate; New Octagon Turret to Devil Tower; York, Lancaster, Chester, Prince of Wales's, Brunswick, George III., and Round Towers; George IV. Gateway; a great length of walling; a new Turret to the Stuart Buildings; Grand Entrance Tower; Front of St. George's Hall; Kitchen Gateway; and two octagon Turrets; Gallery from the Devil Tower to St. George's Hall, 550 feet long, new terrace 1060 feet long, some part of the walls of which is 30 feet high, lowering the court-yard from three to six feet, removed 13,000 cubic yards. Internally :—His Majesty's apartments with a corridor 500 feet long, kitchen and servants apartments, state apartments, St. George's Hall: ball-room; Waterloo Gallery; grand staircase. In the Waterloo Gallery George IV. placed the series of portraits painted by Sir Thomas Lawrence. In the reconstruction of the Keep Sir Jeffry managed with great skill to sustain the increased weight of this enormous pile on an artificial rock of concrete. During the reign of William IV. and Queen Victoria, the works left unfinished by George IV. were successfully prosecuted by Sir Jeffry, until his death in 1840, when the task devolved upon Mr. Henry Ashton, by whom the new stables are being constructed at an expense of 70,000*l*.

As Windsor Castle has employed the talents of some of the most celebrated of our architects and artists, we thought that the following chronological account of officers and persons employed, drawn up by us from Mr. Poynter's materials would prove of interest to our readers.

1173. Master Geoffry, master of the works.

1179. Master Osbert, ditto.

1223. John le Draper and William, the clerk of Windsor, ditto, (Master Thomas, the king's carpenter).

1225. (Master Nicholas, the king's carpenter, allowance for a gown 15*s*., Master Jordan, ditto).

1228. William de Millars, constable of the castle.

1237. William de Burgh, director of the works.

1240-52. (Friar William of Westminter, a painter, and John Sot his assistant).

1241. (Master Simon, king's carpenter).

1260. (Master John of Gloster, king's mason).

1261. Richard de Fremantle, Custos of the manor of Cookham and Bray.

1350. (John de Spaulee, master of the stonehewers).

1351. James de Dorchester, deputy constable of the Castle.

1356. William de Wykeham, surveyor, (Bishop of Winchester), salary a shilling a day, a shilling extra while travelling, and three shillings per week for his clerk. He succeeded Robert de Bernham and Richard de Rochell who had the same salary. In 1357 Wykeham obtained an increase of a shilling a day.

1363. William de Mulso, canon of Windsor, surveyor.

1366. (John, canon of St. Katharine's, king's painter; John or William de Lyndesay, of London, wood carver).

1387. Adam de Hertyngdon, canon of Windsor, surveyor or clerk of the works; (William de Burdon, king's painter).

1390. Geffrey Chaucer, clerk of the works, salary two shillings a day, with privilege of appointing deputy.

1391. Unknown.

1474. Richard Beauchamp, Bishop of Salisbury, surveyor of the works. (Henry Jennings, master mason: Thomas Canceler, clerk of the works, salary 10*l*.; John Tresilian, master smith, 1*s*. 4*d*. per day. The clerk of the works, master mason and master carpenter had gowns allowed them. Robert Ellis, John Filles, Derrick Van Grove and Giles Van Castel, carvers.)

1481. Sir Reginald Bray, surveyor of the works.

1505. (John Hylmer and William Vertue, contractors for the stone work of the roof of St. George's Chapel).

1524. (Benedetto, artist, employed on Wolsey's tomb).

1575. Humphrey Muhill, clerk of the works; ditto, comptroller, 2*s*. per day; Henry Hawthorne, clerk of the works, 2*s*. per day.

1603. Sir John Norris, comptroller; Sir John Trevor, surveyor of the works.

1637. Sir Robert Bennet, surveyor of the works; (David Ramsay, Esq., king's clockmaker).

1639. (Christopher Van Vianen of Nuremburg, makes the plate for the Chapel).

1660. Sir John Denham, surveyor-general; Sir Christopher Wren, deputy.

16—. Sir Christopher Wren, surveyor-general; Baptist May, clerk of the works.

1676. (Antonio Verrio, painter; Grinling Gibbons, carver).

1679. (Josias Ibach Strada, casts statue of Charles II).

1707. (Henry Wise, landscape gardener).

1710. (Sir James Thornhill, painter).

1746. (William Kent, painter).

1778. George III. builds Queen's Lodge after his own designs.

1787. Mr. Emlyn restores part of St. George's Chapel.

1795. (Benjamin West, painter; Jarvis and Forest, painters on glass).

1796. James Wyatt, surveyor-general.

1815. (Sir Thomas Lawrence, painter).

1824. Sir Jeffry Wyatville, surveyor-general; (Sir Richard Westmacott, sculptor).

1840. Henry Ashton, architect.

The description of the plates is far from being so copious as we could wish, being confined principally to an account of the alterations made by Sir Jeffry Wyatville; but it is but fair that we should mention that Mr. Poynter is not responsible for this portion of the work. It is mentioned in describing the Round Tower, that Sir Jeffry being unwilling to disturb the associations of the spot, has provided holes in the stonework of the Castle for the jackdaws and starlings who build here in numbers, to form their nests in. They are for the most part invisible from below, except between the corbels of the battlements of the Keep. From the level of the road on the west side, to the top of the flags left of the Keep, is a total height of 203 feet, of which the Flag Tower is 25 feet, and the flag staff 50 feet; the diameter of the Keep is 102 feet.

On the Nature, Properties, and Applications of Steam, and on Steam Navigation. From the seventh edition of the Encyclopædia Britannica. By John Scott Russell, M.A., F.R.S.E. Edinburgh: Adam and Charles Black.

The volume before us comprises, in addition to the articles on the above subjects which are printed in the Encyclopædia, an historical account of the origin and progress of the art of steam navigation down to the year 1839, by the same author; besides the account of the locomotive steam-engine, from the Treatise on Railways by Lieutenant Lecount.

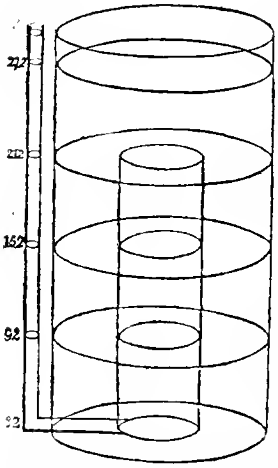
The present articles, STEAM and STEAM-ENGINE, in the Encyclopædia Britannica, are intended to contain all that was interesting and valuable in the original articles (written by Dr. Robison,) with Mr. Watt's notes, enriched by the results of subsequent labour and research; and it has been the author's aim, as he states in the preface to the present volume, "to add to all that Robison had originally said of

Watt's invention, what he would have required to add if he had lived to witness its present extended use, its multifarious applications, its varied forms, its modifications in material and construction* He has endeavoured to place before the reader, in a simple form, all the most important information which many years of research and of practical experience in a favourite subject have placed in his possession: and "the reader who is familiar with the subject will," he says, "readily discover that he has read and thought for himself, and that his errors, if many, are at least his own. In one point he trusts he has facilitated the progress of the student. While giving the general reasoning of complex calculations, he has endeavoured to disembarrass them as much as possible of that parade of calculus which exhibits the author at the expense of the reader; and rather to present their results in that simple form in which alone great truths present themselves to those who thoroughly understand them."

The plan of the work here laid down is in accordance with the nature of an Encyclopædia, which, being a work of a popular character, and a book of reference rather than instruction, many, if not the majority of its readers, moreover, being uninitiated in the arcana of abstruse mathematical science, and therefore willing to take for granted the truth of propositions, the demonstration of which they are unable to comprehend, should not be unnecessarily encumbered with complex and difficult calculations. It should, however, at the same time be borne in mind that some, and we trust we may say many, of the readers of the Encyclopædia are possessed of sufficient scientific knowledge to enable them to think and judge for themselves. Therefore, although the facts advanced should in general be such as are recognized by the best acknowledged authorities, and in support of which it suffices in most cases to cite the authority, yet, when any *new* proposition is enunciated, or any new doctrine propounded, it should be accompanied by a rigorous demonstration, or it must incur the risk of being rejected as unfounded. There are two instances in the work under review, in which we do not find the reasoning adequate to justify the conclusion; we allude to the determination of the *best vacuum* in the condenser of a steam engine, page 276, and of the best proportion of power to tonnage in sea-going vessels, page 288. We must, however, remark, in justice to the author, that we have seldom, if ever, met with a work so full of typographical errors, by which so much unnecessary labour is imposed on the reader, that many are deterred from attempting to make themselves masters of the author's meaning, and which are in some cases so serious as perhaps even to render the accomplishment of the task impossible. Some of the errors are of such a nature that it is difficult to decide whether they are to be ascribed to the author or to the printer.

The article STEAM, which occupies nearly the first half of the volume is on the whole a valuable contribution, particularly the second section, in which are collected together all the most recent experimental researches concerning the elastic force of steam at different temperatures, as well as the most esteemed of the earlier experiments, accompanied by figures of the apparatus employed.

In the first section, where the properties, phenomena, and application of steam are considered in a general manner, there is the following simple illustration of the doctrine of latent heat by Dr. Dalton, from which those who are not familiar with the operations of heat may form a tolerably correct notion of the phenomenon in question:



The liquid and its vapour may be considered as two reservoirs of caloric, capable of holding different quantities of that fluid. Let figure 1 represent to us such an arrangement; the internal cylinder of smaller capacity, the external one of enlarged capacity surrounding and extending far above it, and a small open tube of glass, communicating freely at the bottom with the internal cylinder. Let us now conceive water to be poured into the internal cylinder, the water will manifestly flow into the slender tube till it stand on the same level in the tube as in the cylinder. If any additional quantity be now poured into the internal cylinder, the rise of water in the slender glass tube will serve as an index of the quantity of added fluid; and when it is filled to the top, the fluid will stand at the height marked 212°, and will still be a correct index of the addition of fluid. But if more water be now added to it, it will not make its appearance in the slender tube, but will simply overflow from the internal cylinder over into that of enlarged capacity, so that, while a large quantity is passing into the vessel and gradually filling it up to 212°, no additional rise takes place until the whole of the outer cylinder becomes filled to that point, after which any further addition will again become sensible, by a corresponding rise in the tube. This process is in precise analogy to the succession of circumstances in heating a liquid, and converting it into steam. The internal cylinder represents the liquid, the external one the vapour of greater capacity, and the slender glass tube at the side the thermometer placed in communication with them. When heat flows into the liquid, it passes equally into the thermometer; and each increment of the one produces an equal increment in the other, until the liquid reaches the limit of its capacity, when it suddenly begins to enlarge its bulk and take the form of steam; but the quantity of heat required to fill up this enlarged capacity is so great, as to require about $5\frac{1}{2}$ times as much to fill it as was contained in the whole liquid before, so that all this time the thermometer is standing still, and it is not until the whole of the steam is thus supplied with 212° of caloric, that the thermometer will begin to show any further elevation; after which, any increment of heat thrown into the steam will make its appearance on the thermometer, and proceed as formerly, by simultaneous increments.

* The article on the Steam-engine is, we believe, published in a separate volume; but, as we have not yet seen it, we are unable to notice it in this month's Journal.—ED. C. E. & A. JOURNAL.

As a practical application of the influence of pressure on the boiling point of water, the following rule is given for finding the heights of mountains by boiling water:

Boil pure water in an open vessel at the bottom of the elevation, and observe on the thermometer the point at which it boils. Boil it again at the top of the mountain, and observe with the thermometer the point at which it now boils: the difference of temperature, multiplied by 530 feet, will give a close approximation to the height of the upper above the lower station.

This will give an approximation; but, if greater accuracy be required, it will further be necessary to correct for the difference of the temperature of the air at the two stations, in the following manner. Add the temperatures of the air at the stations, and subtract 64 from their sum, multiply the remainder by one thousandth part of the height found; and this will be the correction to be added to the height formerly found. The result thus found will still require a slight correction for the figure of the earth and latitude of the place; but this does not amount to more in our latitude than an addition of about two feet in a thousand, which forms a second correction.

To illustrate the mode of deducing heights from the boiling point, as we have given it, we take the following example.

Water boils on the top of Ben Nevis at 203·8°, while at the side of the Caledonian Canal it boils at 212°, the temperature being 30° on the summit of the mountain, and 35° below. In order to determine the height,

From 212°	
Take 203·8°	To 30°
	Add 35°
There remains 8·2°	
Multiply by 530	Sum 65°
	Subt. 64°
246·0	
410	Remain 1° mult. by 4·346
4346 first approx.	Latitude 56° nearly
4 first correct.	Mult. 4·350
	by 2·
4350 second approx.	
8·7 second correct.	8·700

Calc. height, 4358·7 third approximation.

4358· true measured height—the difference being less than 1 foot.

This method, however, is seldom susceptible of so high a degree of accuracy, even with the most carefully conducted experiments.

There is also a description with explanatory figures, of the elegant and compact apparatus contrived by the Rev. F. J. H. Wollaston for facilitating the procedure of taking the observations with the requisite precision.

Among the contents of the second section we may mention, as particularly worthy of notice, the abridged account of the experiments undertaken by the French Academy of Sciences, and conducted principally by the M. M. Arago and Dulong, having for its object the discovery of the relation existing between the temperature and elastic force of steam; and those conducted, with the same object, by the committee of the Franklin Institute of Pennsylvania, appointed to examine into the causes of the explosions of the boilers used on board of steam-boats, and to devise the most effectual means of preventing the accidents, or of diminishing the extent of their injurious effects. The former were completed in 1829, and are in every respect entitled to a larger share of confidence than the latter, as well on account of the greater perfection of the apparatus employed and the extraordinary care bestowed upon the manipulations, as the names of two philosophers so well versed in experiments of a similar nature.

In the 3rd section, *on the mathematical law which connects the elastic force of vapour with its temperature*, Mr. Russel has certainly laid before his readers a considerable collection of formulæ (15 in number) previously proposed by divers authors to represent that law, none of which are applicable but in a limited extent of the scale; but we are surprised to find that he has made no mention of that proposed by Mr. A. A. Mornay in the second volume of our Journal, page 200, which represents Dalton's experiments below 212°, and those of the French Academy up to 24 atmospheres, (beyond which they did not extend) within 2·45 degrees Fahr. at the latter limit, where a new formula, proposed by the author of the present work, gives a difference of 10·26 degrees.

In the reasoning through which he arrives at this formula, we rather suspect that Mr. Russell has fallen into the error he deprecates so much in his preface—that of *exhibiting the author at the expense of the reader*, though we think his *parade of calculus* only calculated to dazzle the *very* ignorant, without being intelligible to the mathematician. What, for instance, do the series α, β, γ, and the equations δ, ϵ, (page 113) signify? We confess they are above our comprehension, but perhaps some more profound mathematician might be able to explain their meaning, and to point out their connexion with the laws of temperature and pressure, mentioned in the previous part of the paragraph, and with each other. By some means, however, we are led to the equation, (page 116)

$$\frac{t+121}{333} = (1{\cdot}11401)^{\frac{\log F}{\log 2}}, \qquad \text{T}$$

which appears in an entirely different form from any other that has been published, but which differs in fact from Tredgold's only in the values of the constants; it is, indeed, when freed from logarithms, nothing more or less than the following:

$$F = \left(\frac{t+121}{333}\right)^{6{\cdot}42}.$$

Mr. Mornay's formula alluded to above, possesses this great advantage over the others, that it furnishes a very simple equation for finding the elastic force of steam in terms of its density alone, which is necessary in calculating the effect of steam used expansively in steam engines. Regarding the density of steam Mr. Russell has given no calculations at all, although, besides the formula just alluded to, one has been proposed by Mr. Navier, and a modification of it employed by the Count de Pambour in his *Theory of the Steam Engine*, published in 1839; but there is in the 4th section a very comprehensive table of the density of steam at different temperatures, by Gay-Lussac, as well as an engraving and description of the simple and elegant apparatus used by that philosopher, with his method of operating.

The 5th section, *on the application of our knowledge of the properties, phenomena, and laws of steam to practical and economical purposes*, is interesting as far as it goes; but, as we stated at the beginning of this notice, the most important application, the Steam Engine, is published in a separate volume.

The article STEAM NAVIGATION might, with greater propriety, be entitled "the Steam Navigation of Scotland and the United States," the share of that part of Great Britain called England being represented by the following paragraph:

"To the talent of Mr. Maudslay of London, the present marine engine owes the introduction of that high degree of precision in its construction and details, which gives it so much durability and efficacy as a machine."

From the tenor of this article it would appear that the author was utterly ignorant of the numerous steam boats with which the river Thames is studded at all hours of the day, and some of which vie in speed with the vaunted American steam boats, and that he knew of no steam vessels which navigate the ocean with other than Scotch engines. He does not say (is he ignorant of the fact?) that the Great Western, with Maudslay's engines, makes better passages to New York than the British Queen, with Napier's. The history of the progress and present condition of the art, as here traced, thus bears reference only to the two countries named above—Scotland and the United States; it is, however, as such, interesting enough, but would be rendered much more so, if combined with the history of the art in England.

The following paragraph in page 268, taken in conjunction with the omission of all mention of Maudslay's four cylinder engine, and with the description of Humphreys' trunk-engine, accompanied by a wood cut, in the preceding page, would corroborate the opinion that the author had but a very limited knowledge of the state of Steam Navigation in England.

For a like purpose, oscillating cylinders have been used with some measure of success. Rotatory engines have been unsuccessfully tried. The reader may now examine the vertical engines in the plates.

We believe the only trunk-engine yet made is that of the Dartford, which turned out a failure, while many steam boats now running on the Thames are fitted with oscillating engines, among which are some of the swiftest boats on the river.

We copy the following proof of the doctrine that *the vacuum in a condenser may be too good*, or rather that any improvement in the vacuum beyond a certain limit must be obtained at the expense of more fuel than it is worth; because it is not altogether without foundation, but, by reason of false notation, seems a tissue of absurdity and contradiction.

Let t = the caloric of water of 1°.
c = the constituent caloric of water in the state of steam.
e = the total force of steam in the boiler in inches of mercury;
and x = the elastic force of steam at the temperature of best condensation which we seek to discover.

Then from the law which connects the elastic force of steam with temperature, as already determined in our treatise on Steam, it follows, that in the case of maximum effect, or the temperature of best condensation,

$$\frac{t}{c} = \frac{x}{e} \text{ that is } x = \frac{e\,t}{c}$$

now $c = 1000$, and if the steam in the boiler be at 5 lb. above the atmosphere, or if $e = 40$ inches of mercury, and $t = 1$.

$$x = \frac{40}{1000} = 0{\cdot}04$$

Again, if the steam be at $7\frac{1}{2}$ lb. = 45 inches,

$$x = \frac{45}{1000} = 0{\cdot}045$$

Again, if the steam be at 10 lb. = 50 inches,

$$x = \frac{50}{1000} = 0{\cdot}05$$

Hence, we find that the best elasticity or temperature in the condenser depends on the elastic force of the steam in the boiler.

With steam of 5 lb. in the boiler, the elasticity of maximum effect in the condenser is at 93° of Fahrenheit, and the best vacuum in the barometer is 28. With steam of $7\frac{1}{2}$ lb. in the boiler, the elasticity of maximum effect in the condenser is 95° of Fahrenheit, and the best vacuum in the barometer is 27·8. With steam of 10 lb. in the boiler, the elasticity of maximum effect in the condenser is 97°, and the best vacuum in the barometer is 27·5. In like manner it would be found that with steam of 50 lb. in the boiler, worked expansively, as in Cornwall, the best vacuum in the condenser would be about 26° on the barometer.

Our first impression on reading this proof was that it was altogether fallacious, and, as the calculation was not supported by reasoning, it was not likely to convince us of the contrary; but, on consideration, it seeming probable that the general proposition was true, although Mr. Russell's equation was not the interpretation of a truth, we investigated the subject more closely, and found that this equation did not represent the author's own opinion, but that x ought to stand for the increment of elastic force due to the increment t of heat at the temperature of most advantageous condensation, that c ought to represent the total quantity of caloric required to evaporate water from that temperature, and not merely the amount of latent heat at 212°, and that e should express, not the total pressure in the boiler, but the mean effective pressure on the piston before the allowance for friction has been deducted. The equation should therefore stand thus, retaining x with the signification first assigned to it by Mr. Russell, and expressing by *dif.* x a very small difference of elastic force, and by *dif.* t the corresponding very small difference of temperature,

$$\frac{dif.\ x}{e} = \frac{dif.\ t}{c};$$

the explanation of which is as follows:

The first member expresses the ratio of an assumed small gain of power to the total power exerted by the steam, and the second member the ratio of the quantity of heat thereby abstracted from the feed water (which must be restored in the boiler at the expense of a proportionate quantity of fuel) to the total amount of heat requisite to convert it into steam, or, which is the same thing, the ratio of the extra fuel to the total quantity used. Now it is obvious that, if these two ratios are equal, that is, if the increase of power is in proportion to the increase in the consumption of fuel, there is no gain of duty, and, of course, if the second member were greater than the first, the result would be a diminution of duty.

If we make the small difference of temperature = 1°, as Mr. Russell has done, *dif.* x will express the increment of force due to an increment of 1° of temperature; and, if we suppose the best temperature of condensation to be 100°, we shall have $c = 112 + 1000 = 1112$, and the above equation may be put in the form,

$$dif.\ x = \frac{e}{1112}.$$

If the pressure in the boiler be about 5 lb. above the atmosphere, we shall not have a greater mean pressure than about 30 inches in the cylinder, in which case

$$dif.\ x = \frac{30}{1112} = 0{\cdot}027.$$

This is about the difference between the elastic force of steam at 72 and 73 degrees, according to Dr. Dalton's latest experiments, and the force at 73° is 0·95 inch; so that, when the mean pressure in the cylinder is 30 inches, and the barometer without stands at 29½ inches, the condenser barometer should mark 28·55 inches.

The calculation of the best proportion of power to tonnage (page 288) is so confused by errors (of the press?), that we have no leisure at present to wade through it.

The article on *the immediate Mechanism of Propulsion* is defective in as much as the Archimedean Screw Propeller is not so much as mentioned, and the author seems to have formed an erroneous idea of the principle of Morgan's Paddle Wheel, in consequence of a trifling resemblance which it bears to Oldham's Wheel. See the article *On Paddle Wheels* in the Appendix to the new edition of "Tredgold on the Steam Engine."

The Historical Sketch of Steam Locomotion, by Lieut. Lecount, forms an interesting appendix to the work, which on the whole contains much useful information on the subject of steam, perhaps more than is to be found combined in any other volume of its size, although we do not think it does full justice to its title, particularly in what regards Steam Navigation, as we have already observed.

ON WIERS OR DAMS ON RIVERS.

Observations on the Effect produced by erecting Weirs or Dams on Rivers, and on their efficacy for Navigation Purposes.

By William Bull, Civil Engineer.

Weirs are generally erected either for the purpose of raising a head of water for the use of mills, or for the purpose of navigating the channel of a river, and they cause in the first instance a permanent elevation of the ordinary surface of the water.

If a weir has the same length of top surface as the section of the river at the place where it is erected, it will cause such flood waters as would have been retained within the natural banks of the river, before it was erected, to rise above them in proportion to its height, and overflow the adjoining lands if artificial embankments of proportional height are not erected to prevent it.

When more water comes down the river than its banks could have previously held, then, although the weir causes an increase of height, the evil is less in proportion than in the former case.

In extreme floods, when the water would rise far above the surface of the valley, the small increase of height caused by the weir is of little or no consequence, as other causes generally exist, such as embanked roads leading to bridges, and the contraction of the stream by the bridges which obviates the effect of the weirs; unless the latter be situate at or close to the bridge.

Weirs cause the beds of rivers to rise by retaining the sand and gravel brought down by the stream, with much more rapidity than the adjoining lands rise from the deposit of lighter silt first in the upper portions of the rivers where they are erected, and ultimately throughout their course as far as the weirs extend, by which the sectional area of the rivers is diminished and of course the land adjoining rendered more subject to floods.

This is an evil that may be partially remedied by dredging and embanking. I say partially, because, from the manner in which the former is usually done, (*i.e.* only with a view to keep open a narrow channel in the river for the use of boats,) it has very little tendency to produce it, and if done to the whole extent of the river, would become a very expensive operation, and the latter, even when well executed at first, being constantly liable to delapidation, is for ever subjecting the lands to inundation. This is particularly illustrated in Holland, where the rivers, having been dammed up and embanked, have been permanently elevated above the adjoining lands, and where destructive inundations are by no means of rare occurrence.

Where no weirs exist, rivers have generally a tendency to deepen their beds (particularly if the water is confined to a channel of moderate width) from their source to their confluence with the sea, or until they arrive at an estuary or low flat track of land, when the sand and gravel or other material driven or borne down by the water, is either deposited in such estuaries or on bars at the river mouths, or is dispersed along the shores of the sea by the tidal wave.

I have observed many instances of the gradual lowering of the beds of rivers, but more particularly one which has recently come under my observation, where the out-fall of a mill-goit has been lowered two feet in about four years. This phenomenon is, of course, most obvious where the fall in the river is greatest, all other circumstances being equal.

By making a weir of greater length than the general section of the river, and by widening the river above and below the same, a part of the injury to adjoining lands by raising the surface of the water may certainly be avoided, so long as the river is continued of the increased width, and by extending the length of the weir and the widening of the river to a great or almost indefinite extent, both in line of the current as well as in width, the injury to adjoining lands may be nearly if not entirely obviated for a limited time, but it can only be for a limited time without constant care and attention, and a considerable periodical outlay, (much more of each than is usual or likely to be devoted to such purpose,) because, from the surface of the water being extended, the stream will become proportionally sluggish, particularly towards one or both sides, where, as well as in the natural bed of the river, the matter brought down by the stream will be deposited, and the river will again assume its original width or nearly so, and render the increased length of the weir of little or no avail. The time which will expire before the river assumes its original width will depend materially on the quantity of matter held in suspension by the water, or driven forward by the impetus of the stream, and on the velocity of the stream above and at the point where the weir is erected.

In such instances as where, for some distance before arriving at the weir, the fall and consequent velocity of the stream is of a moderate degree, and where the upper surface of the river has been enlarged, and thereby the velocity of the current diminished, there being only a light alluvial matter and sand held in suspension, or driven forward by the stream, such matter will be rapidly deposited on the sides of the river, until the sectional area is again so contracted as to increase the rapidity of the current to its original rate.

If, instead of the fall and velocity being of that moderate degree which will only carry forward the lighter matter, it is of such a degree as to force down gravel and other heavy matter, the length of the pond first caused by the erection of the weir will be gradually diminished, until the whole of the original bed of the river is filled up to the weir, so as to form the inclination of the new bed at nearly the same angle as it was before the weir was erected; but in this case the contraction of the stream to its original width will go on much more slowly than in the former case, arising from the filling up of the bed, causing the velocity of the stream to be reduced in a less ratio than it would have been if the heavier matter had not been brought down into the original bed of the river.

If the bed of the river is constantly dredged, so as to keep it of its original depth to the upper end of the pond formed by the weir, then the top surface will contract much more rapidly than in the last case, until it arrives at or approximates to its former width, as in the first case by reason of the heavy material being prevented by the dredging from raising the body of the stream so much as it would have done had no dredging been used, and the consequent less velocity of the stream allowing the lighter matter to be deposited at the sides.

From the foregoing observations it will follow that the increased length of the weir, and accompanying width of the river beyond its former dimensions, renders but a partial and temporary advantage, in diminishing the damage to adjoining lands arising from the erection of such weir, and that such erection, whether of greater length than the section of the river or not, does not in itself provide a permanent means of navigation.

Many instances of the inadequacy of weirs for supplying a permanent means of navigating natural rivers may, I have no doubt, be adduced. In the instance of the Calder and Hebble navigation, where I have been practically acquainted with the subject for the last eight years, they are abundantly manifest, as well as in the adjoining navigation of the Aire and Calder, with which I am well acquainted, the proprietors of both of which have been for many years adopting means to avoid the natural stream by substituting cuts or canals.

When first the River Calder was made navigable, it was divided into pools by weirs of sufficient height to give the required depth of water and these weirs were passed by means of locks; but it was soon found that the matter brought down by the stream was rapidly filling up the pools, and consequently diminishing the depth of water, whereby the navigation was much impeded; this was first most apparent at the upper ends of the pools, where the heavy materials, such as gravel and boulders, were first deposited on coming in contact with the comparatively still water produced by the weirs, and as the stream advanced, by deposit of the sand and lighter materials further down. At first recourse was had to remedy the evil by raising the weirs by means of boards, which were frequently washed away by the floods, and had to be renewed as the water subsided, and partly by raking the gravel and sand to the sides of the river. But as soon as the power of the dredging engine became known, recourse was had to it; it was, however, still found that although they had procured and kept in constant work two of these engines, the deposit was gaining on them; they therefore had recourse to the adoption of canals, as before stated, commencing with those parts which were the most affected by the deposit, until they now use only a little more than four miles out of a distance of twenty-two miles of the river. The Aire and Calder Company now use about nineteen miles out of forty-three, by having recourse to dredging, and raising their weirs by means of boards, as before described. That they, are enabled at present to navigate a greater proportion of the rivers than their neighbours, no doubt arises principally from the circumstance of their being situated further down the stream, and their being numerous weirs above, which retain the sand and gravel from coming down to them.

I cannot conclude these remarks better than by giving the result of my observation and experience, which is that converting natural rivers into artificial navigations by erecting dams across them, is much to be deprecated. First, because the dams cause the adjoining lands to be more frequently overflowed than they otherwise would be. Secondly, because dams obstruct the ordinary drainage of the country. Thirdly, because the object sought is but imperfectly obtained, and lastly, because it is the means of materially retarding, if not of entirely preventing, the adoption of the more efficient means of providing for inland navigation by artificial canals, which, if made at all, are rarely or never made so complete as they would have been had no attempt been made to adapt the natural rivers.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

March 9.—The PRESIDENT in the Chair.

"*Description of the Arched Timber Viaducts on the Newcastle and North Shields Railway, erected from the designs of Messrs. John and Benjamin Green; and on the application of the same system of construction to oblique and other Bridges, to the Roofs of Railway Stations, and to other large Buildings.*" By Benjamin Green.

The construction of viaducts and bridges forms so important an item in the cost of a railway, that the engineer is induced to devise new methods of completing his works with due regard to stability and durability, and at the same time with the least possible expense. Stone and brick have been the materials most generally used for bridges; cast iron has been introduced where the heights were too low for the spans, in large arches, or in trussed beams where a certain clear space beneath was required, with only a limited height to the level of the rail. Timber, from its lightness, strength, and cheapness, has been extensively used, but only in spans of limited extent, owing to the sole mode of its application being by framed trusses, upon the same principles as those usually employed for roofing.

These considerations induced Mr. John Green, as far back as the year 1827, to make a design and model for a bridge, with timber arches resting upon stone piers. In 1833 the plan was adopted, and in 1837 it was put into execution at the Ouse Burn Viaduct, where the construction was of great extent, and the cost was an important consideration.

The Viaduct is 918 feet in length, and 108 feet in height from the bed of the river. There are five arches, the versed sine 33 feet, and the radius 68 feet; three of them are 116 feet span each, and two are 114 feet each: two stone arches of 40 feet span each have been introduced at each end to give length to the abutments, and to prevent the embankments from being brought too near to the steep sides of the ravine. The piers are of stone: the springing stones for the three ribs, of which each arch is composed, are on offsets, within 40 feet of the top of the piers; cast-iron sockets are there bedded in the masonry, and secured so as to receive the feet of the ribs. Two of the piers are placed upon piles; the others are founded upon the rock: immediately beneath the centre of one of them an old coal-pit shaft was discovered, and close adjoining to it the remains of the working of a coal seam: both were rendered secure by being filled up with grouted rubble masonry.

The ribs for the arches are composed of planks of Dantzic deal (Kyanized): the lengths vary from 46 feet to 20 feet, by 11 inches wide and 3 inches thick: they are so disposed, as that the first course of the rib is two whole deals in width, the next is one whole and two half deals, crossing the joints longitudinally as well as in the depth. Each rib consists of fourteen deals in thickness, bent over a centre to the required form, and secured together by oak treenails 1½ inch diameter at intervals of 4 feet apart, each treenail traversing three of the deals. A layer of strong brown paper dipped in boiling tar is placed between the joints, to bed them and exclude the wet. Trussed framings and beams are secured upon the arched ribs; the platform composed of planks, each 11 inches wide by 3 inches thick, is spiked down and covered with a composition of boiling tar and lime mixed with gravel in laying on, forming a coating impervious to the wet; upon this platform the two lines of railway are laid, leaving a foot-path between them.

The centreing for turning the ribs was very light and simple, and as every convenience was afforded by having a railway with travelling cranes along the sides of the piers, a whole centre could be moved by twenty men from one arch, and fixed in another in one day.

The author then describes the construction of the Wellington Viaduct, and that which has been erected by him at Dalkeith for the Duke of Buccleuch; giving the relative costs of the three structures which have been mentioned, and stone buildings of the same dimensions: whence it appears that in the Ouse Burn Viaduct there was an economy of £9000, resulting from the adoption of this system.

He then shows the application of this system to the structure of oblique bridges, particularly where a certain clear space is required beneath, and the total height is limited: this is illustrated by a description of a bridge of 71 feet span, on the Newcastle and North Shields Railway, which crosses the turnpike road at Walker, and by one erected over the River Wear on the West Durham Railway.

He describes also the application of the same system to the extensive buildings and sheds of the Shields Railway Station; to churches and to private houses: in the latter the arched form is very advantageous in gaining space for the upper rooms, showing at the same time the economy resulting from the adoption.

The paper is illustrated by a series of nine elaborate detailed drawings, showing the application to every kind of construction.

Mr. Rendel remarked, that on those railways where first cost was a matter of importance, the introduction of a superior kind of Timber Bridge was a great desideratum. The communication proposed the application of tarred paper between the joints, from experience he could not recommend either paper or felt in such situations. He found that both substances prevented the intimate contact of the surfaces of the timber; in all framings exposed to the action of the weather the tar was absorbed by the wood; the paper and felt then became saturated with and retained the moisture, so that decay very speedily ensued. The mode he at present adopted was to have all the joints and mortices of the framings very closely fitted, leaving only sufficient space at the edges to be caulked with oakum, and the joint run with pitch, like the seams of the deck of a vessel. Wherever it was practicable, great advantage would result from covering the joints with sheet lead, to exclude the moisture and prevent the decay, which was the great bar to the more general use of timber in many engineering works.

Mr. Vignoles was inclined to think the curve of the arch was too steep; he should prefer its being flatter. He would not then enter into the subject, but he would present to the Institution a large model of a Timber Bridge, and with it a communication, explaining his views on this subject, which was one to which he had paid much attention.

Mr. Macneil had found constant trouble to result from the decay of wooden bridges. The Dalmarnoch Bridge, which had been erected about thirty years, now demanded continual repairs; the struts were nearly all decayed at the points of insertion into the cast-iron sockets. The original floor had been replaced by one of teak wood.

In answer to a question from the President as to the process of "Kyanizing" timber for the Hull and Selby Railway, Mr. Timperley described the method pursued there. In a close cylindrical wrought-iron vessel, 70 feet long and 6 feet diameter, filled with a solution of corrosive sublimate, the timber was piled, leaving a space along each piece; the air was then exhausted by air-pumps to a vacuum of about 25 inches by the mercury gauge, and by the application of a force-pump, under a pressure of 100 lb. per square inch, the solution was driven into the pores of the timber. From experiments he had made he believed that the timber was thus thoroughly saturated, and although sufficient time had not elapsed to give any correct result as to the comparative duration of the sleepers, he thought very favourably of the process.

The original cost of the timber, which was the best Riga Balk, squared, was 5*l.* 10*s.* per load (50 cubic feet). The expense of "Kyanizing" about 400,000 cubic feet, including the interest of the first cost of the apparatus, was between fourpence and fivepence per cubic foot. The process was carried on with greater rapidity, and much more effectually, than it could have been done in open tanks.

Mr. Lowe was of opinion, that although the mechanical part of this process appeared very effective, it was not really so. There were chemical difficulties: a certain length of time was required to dilute and extract the sap and aqueous matter from the pores. The greater or less duration of the process might in some measure account for the difference of the results practically obtained. Dry planks succeeded better than wet ones; with sound dry timber any solution of the metallic salts, such as the sulphates of iron or copper, was efficacious, but with wet timber he doubted whether any preparation would be effectual.

Mr. Cooper believed that in the process of "Kyanizing" the chlorine united with the albumen, and formed chloride of albumen; it was possible that in the exhausting process the air contained in the timber would expand and prevent the capillary tubes from becoming perfectly saturated with the solution of corrosive sublimate.

March 16.—The PRESIDENT in the Chair.

John Hambley Humfrey was elected an Associate.

"*Description of the Methods adopted for raising and sustaining the sunken Roof of St. George's Church, Dublin.*" By Robert Mallet, Assoc. Inst. C. E.

St. George's parish Church, one of the finest ecclesiastical edifices in the city of Dublin, was completed in the year 1802, from the designs of the late Francis Johnston, Architect to the Board of Works at that time, at a cost of about £90,000.

The church had not been built many years, before the roof, which was covered with ton slating and copper, gradually sunk in several places, by which the cornices at the flank wall were pushed several inches outward. The subsidence slowly but continually increased. The ceiling cracked in various places, the ornamental stucco work began to drop off, and in the year 1836 the state of the roof was such, that the church was deemed unsafe for use, and was shut up.

Messrs. John and Robert Mallet were consulted as to the practicability of restoring the roof. In November, 1836, they reported that they considered the ceiling might be preserved, and described the manner in which they proposed to accomplish it.

The mode proposed consisted in interweaving with and adapting to the timber framing of the roof, a system of metallic framing, so arranged, that all strain or stress should be removed from the former, and borne by the latter, as well as removing all lateral pressure from the walls of the building.

A careful survey of the roof showed that the ends of several of the principals were unsound. A small hole was then bored through the ceiling, close to each queen-post, and a deal rod, ½ an inch square, dropped through each. These rods were all of equal length, and their upper ends were secured level with the top surface of the tye-beam of each principal; then with a levelling instrument placed in the gallery, observations were taken, and the exact amount of the deflection of the framing ascertained. The variation was considerable, but the greatest amount of depression was found to be 5¾ inches. The whole roof was strained and distorted, and was so unsafe that the slightest effort caused vibration throughout.

The causes of this failure appeared to be threefold: a radical want of strength in the framing of the roof; secondly, the employment of unfit tye-beams, which having been constructed during the Continental war, when timber was scarce and dear, were formed almost wholly of short lengths, averaging not more than 20 feet, lapped and scarfed; thirdly, in the queen-posts having been badly constructed and ill placed.

The stone corbels, which supported the oak cantilevers, being originally cut almost through to receive the wall-plate, were nearly all broken in the middle. It was proposed, therefore, to remove the oak cantilevers and stone corbels, and to cut away the timber wall-plate beneath each principal, to level up the wall, placing a suitable cast-iron abutment piece at each end, and to spring from side to side a cast-iron arch, in "double flitches," connected through the spaces of the timber framing by hollow distance pieces, and also by a certain number of equidistant cross-heads, from which should drop down vertical suspending rods, capable of being adjusted in length, and connected with the tye-beam of the principal, so that being drawn up straight, and the respective parts secured, the weight of the whole roof would be transferred through the framing to the tye-beams; whilst they being hung from the system of suspension rods of the cast-iron arches, which would thus sustain the whole load, and their abutments being held together by the tye-bars in the chord line, the load would bear vertically upon the walls.

It was then determined to raise the roof and ceiling by forces applied from below; to cut away the rotten ends of the principals and to reconnect them with the walls by a modification of the cantilever bracket, invented by Mr. Alfred Ainger, and described in the Transactions of the Society of Arts (vol. 42). The whole of the oak cantilevers and stone corbels were to be removed as useless incumbrances.

The total weight of the roof being about 133 tons, each framed principal would sustain about 16½ tons, and each vertical suspending rod about 1½ ton.

Although the weight of material in this roof and ceiling may be considered uniformly distributed, it was impossible to foresee what change might be effected in the framing by forcing the ceiling and roof up to a level line, or what amount of force might bear upon particular points, from the elasticity of the materials being thus forcibly constrained. It hence became a matter of prudence to provide in all parts a large surplus of strength, bearing in mind that, in any complete system, "the strength of the whole is limited by that of the weakest part, and thus that partial strength becomes total weakness." The dimensions of the scantling were accordingly so calculated that the utmost strain upon it should not exceed 4·5 tons per square inch, considering 9 tons to be the practical limit to which wrought iron might be exposed.

After giving the formulæ for calculating the strains upon the different parts of the roof, with the reasons why the theoretical dimensions were in some instances departed from, the author apologises for entering so much into detail of the construction, quoting at the same time the writings of Smeaton and Telford, as abounding in the richest details of theoretic deduction, modified by practical judgment. He then proceeds to describe the means adopted.

Immediately beneath each of the fourteen queen-posts of the roof, an aperture of 30 inches square was cut through the floor of the church, and a piece of brick and cement built up from the arches of the vaults beneath to the level of the floor; on the top of each, a plate of cast iron was bedded, and upon each plate a block of oak timber about 4 inches thick.

Fourteen straight whole balks of Memel timber, each 3 feet shorter than the height of the church between the floor and the ceiling, with their extremities cut square and smooth, were placed vertically upon the blocks; upon this level a platform was laid; across the tops of the vertical balks, pieces of oak scantling were placed; fourteen powerful screw-jacks were then fixed, one beneath each queen-post, and the ceiling cut away for the points to bear directly upon the beams.

During the progress of these operations, the whole of the ceiling and roof framing had been carefully examined. The dust was removed from the joints and open mortices, &c., of the framing, and the cracks in the ceiling were cleared out by passing a fine whip saw through them, so as to permit their closing when the ceiling was raised to a plane surface.

The preparations being completed, the word was given to heave simultaneously upon the screw-jacks; the roof rose slowly and steadily, and as soon as any one of the small deal standard rods had reached the level plane, the motion of the screw-jack at that spot was stopped. In about two hours, the whole roof, together with the ceiling, was brought up level, without any accident or injury to any portion of the ceiling. The cracks in the latter as well as the joints and mortices of the framing were found to be nearly all closed. Some slates were broken, and the copper of the platform, which before was wrinkled and loose, was now found to be drawn tight over the timber sheathing.

The roof being thus supported from beneath, the masonry was cut out round the ends of the principals; the oak cantilevers and corbels of granite, and the rotten ends of the timbers, within a few inches of the inside face of the walls, were also removed.

The cantilever and abutment castings were now applied and bedded with lead and oil putty, on blocks of stone set at the level of the under side of the tye-beams, on footings of brick and cement. The chord bars were next placed, and temporarily adjusted by means of their screw nuts. The arch segments were put up in succession, their centre or key pieces bolted in, and the segments adjusted to them by means of wedges of African oak: the suspending rods were then hung on from the top shackles, and the junction made good with the tye-beams, by means of the lower cross-heads, stirrups, and shackles.

As soon as the whole system of the seven arched frames was complete, and the cantilevers adjusted to the ends of the decayed timbers, standing lengths of pine rods were placed in right lines from centre to centre of each pair of abutment cross bolts, and all the chord bars and suspending rods were brought up by means of their adjustment screws, until the united effort of the whole system had lifted and supported the entire roof and ceiling from the screw-jacks, on which they had previously rested, so that these latter all became loose.

The whole was now left quiet for some days, in order that every part might take its bearing, and that the sufficiency of the structure should be proved before the final removal of the screw-jacks, &c., which remained within about ⅛ of an inch of the blocks beneath the tye-beams, by which means, in case of accident, the amount of fall would have been limited to that small distance. The entire work, including the repairing the cracks in the ceiling, occupied little more than four months, and has never since required either alteration or repair.

The total amount of the contract for this work was 1362*l.* 6*s.* The repair of the injury done to the ceiling only amounted to 33*l.* 0*s.* 8*d.*, and the damage done to the slating, platform, flooring, &c., did not amount to more than an equal sum.

The total amount of cast and wrought iron in the structure was 21 tons 10 cwt. 2 qrs. 19 lb.

The communication is illustrated by five elaborate drawings on a large scale, showing the general arrangement and modes of proceeding, and also the details of the construction of the roof and of the cast and wrought-iron works used in the repairs.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

July 5.—EARL DE GREY, President, in the Chair.

A paper was read by Professor Willis, of Cambridge, Hon. Mem. F.R.S. &c., *On the construction of the Vaulting of the Middle Ages.*

The vaulting of the Gothic architects differs essentially from that both of ancient and modern times, inasmuch as it consists of a combination of ribs, each forming an independent arch, both laterally and diagonally, with the intermediate spaces filled in upon the extrados of the arches to form the spandrils, whereas, according to the ordinary system of vaulting, the whole is solid and keyed together. The principles of this latter mode of construction were first developed by Philibert de l'Orme, who, in his celebrated treatise, lays down the rules for drawing the vaults and setting out the voussoirs —but of the practice of the Gothic architects we have no account, and it remains to be inferred from an examination of their works. That they proceeded by geometrical methods there can be no doubt, though they were probably extremely simple, differing greatly in that respect from those expounded by Philibert de l'Orme. One thing to be especially observed in the plain vaultings of the middle ages is, that all the curves are segments of circles, the diagonals being struck from a centre below the springing of the lateral and cross ribs, and are contrasted in this respect with diagonals projected from the direct arches, according to the rule familiar to every carpenter, from which it results that all the points of a groined vault coincide, and will be touched by a straight line drawn from one end of such a range of vaulting to the other. To this mode of setting out the curves may be attributed the flagrant want of character which is apt to distinguish the modern imitations of Gothic vaulting, and it may even be observed in original examples, that the effect is less pleasing as this coincidence is more nearly approached. This is the case with vaultings executed after the four-centered arch came into fashion, in which, although the curves may not be projected, yet there is an approach to greater regularity from the springing of all the ribs being brought to one level. During the Norman period the drawing of the vaults is very rude, and we find it to have been frequently necessary to back up the extrados of the ribs in order to bring the spandrils into shape. In the succeeding period of our architecture more care was indispensable, on account of the greater complication of mouldings converging together at the springing, and the free and sketchy manner in which they are managed, and the superfluous mouldings got rid of before they overload the impost, is much to be admired, and is greatly superior to the method pursued in the 15th century, when the coverging ribs were all brought down to the impost, and died away into a mere bundle of reeds, of which the effect is exceedingly tame and uncharacteristic. Previously to the introduction of the last style of gothic vaulting, *fan groining*, various complicated figures were formed by the introduction of numerous cross ribs, but the mode of construction continued to be the same. The vaulting immediately preceding fan groining, which may, in fact, be considered as a transition style, Professor Willis designated as *stellar* groining, from the star shapes which usually enter into its composition, and it is remarkable, that in some cases this form is lost in execution, although laid down on the plan, the architect apparently not having calculated on the effect of perspective, whereas, in others, the artist has evidently depended upon it in order to bring out his design. At length, in fan groining, the compartments become so numerous that the system of separate ribs is abandoned, and the vaults are constructed according to the ancient and modern principle of cut stone. Professor Willis accompanied his lecture by an extensive display of drawings and models, illustrative of the geometrical system upon which he supposed the Gothic architects to have worked in producing these results.

After the lecture the noble President presented to Mr. Hall the medal of the Institute, which had been awarded for his essay on iron roofs.

July 19.—R. Wallace, Esq., in the Chair.

Henry Gally Knight, Esq., was elected an honorary member.

Mr. Hall's essay on iron roofs, to which the medal of the Institute had been awarded, was read.

This was the closing meeting of the session.

CALOTYPE.

The following account of some recent improvements in photography, by H. F. Talbot. Esq., was lately read before the Royal Society.

The author had originally intended, in giving an account of his recent experiments in photography, to have entered into numerous details with respect to the phenomena observed; but finding that to follow out this plan would occupy a considerable time, he has thought that it would be best to put the Society, in the first place, in possession of the principal facts, and by so doing perhaps invite new observers into the field during the present favourable season for making experiments. He has, therefore, confined himself at present to a description of the improved photographic method, to which he has given the name of *Calotype*, and reserves for another occasion all remarks on the theory of the process. The following is the method of obtaining the Calotype pictures.

Preparation of the Paper.—Take a sheet of the best writing paper, having a smooth surface and a close and even texture. The watermark, if any, should be cut off, lest it should injure the appearance of the picture. Dissolve 100 grains of crystallized nitrate of silver in six ounces of distilled water. Wash the paper with this solution, with a soft brush, on one side, and put a mark on that side whereby to know it again. Dry the paper cautiously at a distant fire, or else let it dry spontaneously in a dark room. When dry, or nearly so, dip it into a solution of iodide of potassium containing 500 grains of that salt dissolved in one pint of water, and let it stay two or three minutes in this solution. Then dip it into a vessel of water, dry it lightly with blotting-paper, and finish drying it at a fire, which will not injure it even if held pretty near; or else it may be left to dry spontaneously. All this is best done in the evening by candle-light. The paper so far prepared the author calls *iodized paper*, because it has a uniform pale yellow coating of iodide of silver. It is scarcely sensitive to light, but, nevertheless, it ought to be kept in a portfolio or a drawer, until wanted for use. It may be kept for any length of time without spoiling or undergoing any change, if protected from the light. This is the first part of the preparation of Calotype paper, and may be performed at any time. The remaining part is best deferred until shortly before the paper is wanted for use. When that time is arrived, take a sheet of the iodized paper and wash it with a liquid prepared in the following manner:—Dissolve 100 grains of crystallized nitrate of silver in two ounces of distilled water; add to this solution one-sixth of its volume of strong acetic acid. Let this mixture be called A. Make a saturated solution of crystallized gallic acid in cold distilled water. The quantity dissolved is very small. Call this solution B. When a sheet of paper is wanted for use, mix together the liquids A and B in equal volumes, but only mix a small quantity of them at a time, because the mixture does not keep long without spoiling. I shall call this mixture the *gallo-nitrate of silver*. Then take a sheet of iodized paper and wash it over with this gallo-nitrate of silver, with a soft brush, taking care to wash it on the side which has been previously marked. This operation should be performed by candle-light. Let the paper rest half a minute, and then dip it into water. Then dry it lightly with blotting-paper, and finally dry it cautiously at a fire, holding it at a considerable distance therefrom. When dry, the paper is fit for use. The author has named the paper thus prepared *calotype paper*, on account of its great utility in obtaining the pictures of objects with the camera obscura. If this paper be kept in a press it will often retain its qualities in perfection for three months or more, being ready for use at any moment; but this is not uniformly the case, and the author therefore recommends that it should be used in a few hours after it has been prepared. If it is used immediately, the last drying may be dispensed with, and the paper may be used moist. Instead of employing a solution of crystallized gallic acid for the liquid B, the tincture of galls diluted with water may be used, but he does not think the results are altogether so satisfactory.

Use of the Paper.—The Calotype paper is sensitive to light in an extraordinary degree, which transcends a hundred times or more that of any kind of photographic paper hitherto described. This may be made manifest by the following experiment:—Take a piece of this paper, and having covered half of it, expose the other half to daylight for the space of *one second* in dark cloudy weather in winter. This brief moment suffices to produce a strong impression upon the paper. But the impression is latent and invisible, and its existence would not be suspected by any one who was not forewarned of it by previous experiments. The method of causing the impression to become visible is extremely simple. It consists in washing the paper once more with the gallo-nitrate of silver prepared in the way above described, and then warming it gently before the fire. In a few seconds the part of the paper upon which the light has acted begins to darken, and finally grows entirely black, while the other part of the paper retains its whiteness. Even a weaker impression than this may be brought out by repeating the wash of gallo-nitrate of silver, and again warming the paper. On the other hand, a stronger impression does not require the warming of the paper, for a wash of the gallo-nitrate suffices to make it visible, without heat, in the course of a minute or two. A very remarkable proof of the sensitiveness of the calotype paper is afforded by the fact stated by the author, that it will take an impression from simple moonlight, not concentrated by a lens. If a leaf is laid upon a sheet of the paper, an image of it may be obtained in this way in from a quarter to half an hour. This paper being possessed of so high a degree of sensitiveness, is therefore well suited to receive images in the camera obscura. If the aperture of the object-lens is one inch, and the focal length fifteen inches, the author finds that *one minute* is amply sufficient in summer to impress a strong image upon the paper of any building upon which the sun is shining. When the aperture amounts to one-third of the focal length, and the object is very white, as a plaster bust, &c., it appears to him that *one second* is sufficient to obtain a pretty good image of it. The images thus received upon the Calotype paper are for the most part invisible impressions. They may be made visible by the process already related, namely, by washing them with the gallo-nitrate of silver, and then warming the paper. When the paper is quite blank, as is generally the case, it is a highly curious and beautiful phenomenon to see the spontaneous commencement of the picture, first tracing out the stronger outlines, and then gradually filling up all the numerous and complicated details. The artist should watch the picture as it developes itself, and when in his judgment it has attained the greatest degree of strength and clearness, he should stop further progress by washing it with the fixing liquid.

The fixing process.—To fix the picture, it should be first washed with water, then lightly dried with blotting paper, and then washed with a solution of bromide of potassium, containing 100 grains of that salt dissolved in eight or ten ounces of water. After a minute or two it should be again dipped in water and then finally dried. The picture is in this manner very strongly fixed, and with this great advantage, that it remains transparent, and that, therefore, there is no difficulty in obtaining a copy from it. The calotype picture is a negative one, in which the lights of nature are represented by shades; but the copies are positive, having the lights conformable to nature. They also represent the objects in their natural position with respect to right and left. The copies may be made upon Calotype paper in a very short time, the invisible impressions being brought out in the way already described. But the author prefers to make the copies upon photographic paper prepared in the way which he originally described in a memoir read to the Royal Society in February 1839, and which is made by washing the best writing paper, first with a weak solution of common salt, and next with a solution of nitrate of silver. Although it takes a much longer time to obtain a copy upon this paper, yet, when obtained, the tints appear more harmonious and pleasing to the eye; it requires in general from three minutes to thirty minutes of sunshine, according to circumstances, to obtain a good copy on this sort of photographic paper. The copy should be washed and dried, and the fixing process (which may be deferred to a subsequent day) is the same as that already mentioned. The copies are made by placing the picture upon the photographic paper, with a board below and a sheet of glass above, and pressing the papers into close contact by means of screws or otherwise. After a calotype picture has furnished several copies, it sometimes grows faint, and no more good copies can then be made from it. But these pictures possess the beautiful and extraordinary property of being susceptible of revival. In order to revive them and restore their original appearance, it is only necessary to wash them again by candle-light with gallo-nitrate of silver, and warm them; this causes all the shades of the picture to darken greatly, while the white parts remain unaffected. The shaded parts of the picture thus acquire an opacity which gives a renewed spirit and life to the copies, of which a second series may now be taken, extending often to a very considerable number. In reviving the picture it sometimes happens that various details make their appearance which had not before been seen, having been latent all the time, yet nevertheless not destroyed by their long exposure to sunshine. The author terminates these observations by stating a few experiments calculated to render the mode of action of the sensitive paper more familiar. 1. Wash a piece of the iodized paper with the gallo-nitrate; expose it to daylight for a second or two, and then withdraw it. The paper will soon begin to darken spontaneously, and will grow quite black. 2. The same as before, but let the paper be warmed. The blackening will be more rapid in consequence of the warmth. 3. Put a large drop of the gallo-nitrate on one part of the paper, and moisten another part of it more sparingly, then leave it exposed to a very faint daylight; it will be found that the lesser quantity produces the greater effect in darkening the paper; and in general, it will be seen that the most rapid darkening takes place at the moment when the paper becomes nearly dry; also, if only a portion of the paper is moistened, it will be observed that the edges or boundaries of the moistened part are more acted on by light than any other part of the surface. 4. If the paper, after being moistened with the gallo-nitrate, is washed with water and dried, a slight exposure to daylight no longer suffices to produce so much discoloration; indeed it often produces none at all. But by subsequently washing it again with the gallo-nitrate and warming it, the same degree of discoloration is developed as in the other case (experiments 1 and 2). The dry paper appears, therefore, to be equal, or superior in sensitiveness to the moist; only with this difference, that it receives a virtual instead of an actual impression from the light, which it requires a subsequent process to develope.

Plaster Ornaments.—The late Mr. Bernasconi was engaged, we believe, to a greater extent than any other ornamental plasterer of the present century, under all the leading architects of the day. We were lately induced to pay a visit to his former scene of business, in Alfred Street, Tottenham Court Road, now in possession of Mr. Brown, his son-in-law, who has lately arranged the numerous ornaments bequeathed him by the late possesor. They are well deserving of a visit by the architect; here he will find Grecian, Roman, Gothic, Elizabethan, the Renaissance, Arabesque, and almost every other style of ornaments that have been introduced at Windsor Castle, Buckingham Palace, Pavilion Brighton, Stafford House, Westminster Abbey, Fonthill, Woburn Abbey, York Minster, Ely Cathedral, and numerous other public buildings and mansions throughout the United Kingdom.

MISCELLANEA.

WESTMINSTER BRIDGE.

On Thursday, 15th ult., the water was admitted into the coffre-dam inclosing the 15th and 16th piers, and the next day a commencement was made in removing the clay preparatory to drawing the piles. It is intended to open two arches for navigation before any further steps are taken with the next dam, which is to enclose one pier only. A deep water channel is now in progress of being made on the north side of the river, in line with the two arches about to be opened, by a steam dredging engine, for the use of navigation. The present neglected state of the river not only interferes most injuriously with the interests of those who navigate it, but causes the velocity of the current at the latter part of the ebb to be greater than is consistent with safety to the number of small boats and inexperienced persons frequenting the river at this season of the year. It is, therefore, a consummation much to be desired, that a subject so important to the welfare of this great metropolis should receive the attention it deserves, and that the city authorities, aided by government, will yet be able to carry into effect either their former scheme of embanking the river to a more regular line, or some modification of this plan by which the present evils may be removed, so that this noble river may again be restored to its former usefulness.

OPENINGS OF RAILWAYS.

The thirtieth of June witnessed a great extension of the Great Western Railway, as on that day the main line was opened from Chippenham to Bath, 13 miles, the Cheltenham and Great Western to Cirencester, and the Bristol and Exeter from Bristol to Bridgewater, 33 miles. Thus the Great Western Railway is opened throughout 118¼ miles, and there is a continuous line of railway communication from London to Bridgewater of 152 miles in length.

On the 5th of July 28½ miles of the Brighton line were opened, being from the Croydon Junction to Hayward's Heath, and 5 miles from Clayton Tunnel to Brighton, a measure which augurs well for the successful opening of the remainder.

The extension of the Blackwall railway to Fenchurch Street was to take place about the period of our publication, so that all the metropolitan railways would thus be complete at their London termini.

The unfortunate accident to the Fareham tunnel on the Gosport branch of the South Western Railway, has unfortunately delayed the opening of that line, just when it was on the point of being examined by the Government inspector.

GREENWICH RAILWAY.

Amounts of the tenders delivered on the 6th ult. for the fourth contract for widening the Greenwich Railway from the Croydon Junction.

Messrs. Lee	15.825
Mr. Munday	15.990
Messrs. Little	16.189
Mr. Grimsdell	16.536
Messrs. Ward	16.698
Mr. Bennett	16.920
Messrs. Piper	16.920
„ Grissell & Peto	17.280
„ Baker	17.440

THE "PRINCESS ROYAL" STEAMER.

This splendid vessel, which appears to surpass the speed of any other in the north, is now running between Liverpool and Glasgow, and has made several successful trips; she performed a trip from Dublin to Liverpool in 9 hours, and another trip on the 9th ult. from Greenock to Liverpool in 15½ hours, the quickest passage on record, the distance is 227½ miles; she carried at the time 100 tons actual weight. Both the vessel and engines were built by Messrs. Tod & Macgregor of the Clyde Foundry, Glasgow the former is of the following dimensions, viz., 185 feet keel and 208 feet on deck, 28 feet beam, and 17 feet hold above the flooring, draws when light 8 feet, and when full 10 feet of water; her register is 750 tons (N.M.). She is entirely built of iron, (there is not a single beam of wood,) very strong, and has a fine appearance in the water, her cabins are very richly and tastefully fitted up. The vessel is propelled by two steeple or upright engines of 190 horse power *each*, or 380 together; the power is applied direct to the crank. Diameter of cylinders is 73 inches, length of stroke 6 ft 3 in., performs 18 strokes per minute when in good trim, and 17 strokes with from 100 to 120 tons of cargo, diameter of paddle-wheel over floats 29 feet length of float 7 ft. 9 in., and breadth 28 inches, speed in still water 15 miles per hour.

Launch of the Devastation War Steam-vessel—The launch of this first-class war steam-vessel took place at Woolwich, on Saturday, 3rd ult. Mr. Lang, master shipwright, superintended the launch; she was immediately after hauled into the dock, opposite the blacksmith's workshop, where she will be coppered, and will be afterwards taken into the basin to have her engines fitted and made ready for sea. The Devastation is about 189 feet long, and about 1,050 tons burden, old measurement, or about 1,000 tons burden according to the new mode of calculation.

The Cadogan Chain Pier, Chelsea.—Earl Cadogan, the lord of the manor, has erected a handsome and convenient pier for steam-boat passengers on a novel construction, at an expense of between £3,000 and £4,000. This erection was constructed by Mr. Cubitt, from the design and under the direction of Mr. Handford, the surveyor and architect of the manor. The pier is situated in the mall of Cheyné-walk, the most beautiful part of Chelsea, and forms one of the most interesting objects of the place. Shortly the pier will be open to the public.

Professor Wagner's Electro-Magnetic Engine.—The German journals publish the following extract from a protocol drawn up by the Germanic Diet.—"The Germanic confederation desiring to acquire, for the purpose of publishing for the public good, the secret by means of which citizen Philip Wagner, of Frankfort, makes use of electro-magnetism as a moving force, will secure to the said Wagner for the exclusive possession of his secret the sum of 100,000 florins (£8,000 British), on condition that he cause an electro-magnetic machine to be constructed at his own expense, and upon a sufficiently large scale, to serve as a locomotive; that a trial be made of this machine, in order that the diet be assured of its efficacy; and that M. Wagner consented to abide by the decision of the Diet on that trial. The Diet will wait for one month for M. Wagner to accept those conditions.

Land-slip at Sidmouth.—A land-slip of considerable extent took place at Sidmouth on the 11th ult., about seven in the evening. It commenced about half-past six by a rumbling noise, resembling a distant peal of thunder, and at seven o'clock part of the Peak Hill was observed to glide towards the ocean, carrying everything before it, and forming a rock or pillar out of the sea (70 feet high and 175 feet in circumference), opposite to the town, and a quarter of a mile from the shore. It is covered with fossils, and is of a hard iron-like substance. So singular an occurrence has attracted the attention of every one in the town, and hundreds are flocking from the immediate neighbourhood to gain a sight of its results.—*Dorset Chronicle.*

The Dissolving Views at the Royal Polytechnic Institution.—The directors of this scientific institution, ever seeking to combine amusement with instruction, have recently added to their numerous attractions an entirely new series of displayed [illegible] by Messrs. Wrench & Smith, which, for selection of subjects and the [illegible] feeling with which they are treated, may be considered unquestionably the best of the kind hitherto exhibited; there are sixteen in number, and if we may judge from the gratification evinced by the numerous company who attend upon each occasion that these beautiful views are shown, the spirited proprietors cannot but congratulate themselves upon having secured such to an exhibition, which is [illegible] must doubtless become an increasing attraction to this institution.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 28TH JUNE, TO 28TH JULY, 1841.

Six Months allowed for Enrolment.

John Chater, of the Town of Nottingham, machine-maker, and Richard Gray, of the same place, lace manufacturer, for "*improvements in machinery for the purpose of making lace and other fabrics, traversed, looped, or woven.*"—Sealed June 26.

Willoughby Methley and Thomas Charles Methley, of Frith-street, Soho, ironmongers, for "*improvements in machinery for raising, lowering, and moving bodies or weights.*" (A communication.)—June 26.

Moses Poole, of Lincoln's-inn, gentleman, for "*improvements in producing and applying heat.*" (A communication.)—June 26.

William Losh, of Little Benton, Northumberland, Esq., for "*improvements in the manufacture of railway wheels.*"—June 26.

Nathaniel Benjamin, of Camberwell, gentleman, for "*improvements in the manufacture of type.*" (A communication.)—June 28.

William Knight, of Durham-street, Strand, gentleman, for "*an indicator for registering the number of passengers using an omnibus or other passenger vehicles.*"—June 28.

Christopher Nickels, of York-road, Lambeth, gentleman, for "*improvements in the manufacture of mattresses, cushions, paddings or stuffings; and in carpets, rugs, or other napped fabrics.*"—June 28.

William Thomas Berger, of Upper Homerton, gentleman, for "*improvements in the manufacture of starch.*"—June 28.

Thomas Marchell, of Soho-square, surgeon, for "*improvements in raising and conveying water and other fluids.*"—June 28.

George Henry Phipps, of Deptford, engineer, for "*improvements in the construction of wheels for railway and other carriages.*"—July 2.

Thomas Hagen, of Kensington, brewer, for "*an improved bagatelle board.*"—July 7.

George Onions, of High-street, Shoreditch, engineer, for "*improved wheels and rails for railroad purposes.*"—July 7.

Robert Mallet, of Dublin, engineer, for "*certain improvements in protecting cast and wrought iron and steel, and other metals, from corrosion and oxidation; and in preventing the fouling of iron ships, or ships sheathed with iron, or other ships or iron buoys, in fresh or sea water.*"—July 7.

William Edward Newton, of Chancery-lane, civil engineer, for "*certain improvements in the manufacture of fuel.*" (A communication.)—July 7.

Thomas Fuller, of Bath, coachmaker, for "*certain improvements in retarding the progress of carriages under certain circumstances.*"—July 7.

Andrew M'Nab, of Paisley, North Britain, engineer, for "*an improvement or improvements in the making or construction of meters or apparatus for measuring water or other fluids.*"—July 7.

Charles Wheatstone, of Conduit-street, gentleman, for "*improvements in producing, regulating, and applying electric currents.*"—July 7.

John Steward, of Wolverhampton, Esq., for "*certain improvements in the construction of piano fortes.*"—July 7.

Thomas Young, of Queen-street, London, merchant, for "*improvements in lamps.*"—July 9.

Charles Payne, of South Lambeth, chemist, for "*improvements in preserving vegetable matters where metallic and earthy solutions are employed.*" July 9.

William Henry Phillips, of Manchester-street, Manchester-square, civil engineer; and David Hichinbotham, of the same place, gentleman, for "*certain improvements in the construction of the chimneys, flues, and air tubes, with the stoves, and other apparatus connected therewith, for the purpose of preventing the escape of smoke into apartments, and for warming and ventilating buildings.*"—July 13.

Benjamin Beale, of East Greenwich, engineer, for "*certain improvements in engines, to be worked by steam, water, gas, or vapours.*"—July 13.

Moses Poole, of Lincoln's-inn, gentleman, for "*improvements of steam baths, and other baths.*" (A communication.)—July 13.

Miles Berry, of Chancery-lane, civil engineer, for "*improvements in the construction of locks, latches, or such kind of fastenings for doors and gates, and other purposes to which they may be applicable.*" (A communication.)—July 14.

Thomas Peckston, of Arundel-street, Strand, Bachelor of Arts, and Philip Le Capelain, of the same place, coppersmith, for "*certain improvements in meters for measuring gas, and other aeriform fluids.*"—July 15.

Andrew Smith, of Belper, Derby, engineer, for "*certain improvements in the arrangement and construction of engines, to be worked by the force of steam, or other fluids; which improved engines are also applicable to the raising of water and other liquids.*"—July 21.

John M'Bride, manager of the Nursery Spinning Mills, Hutchisontown, Glasgow, for "*certain improvements in the machinery and apparatus for dressing and weaving cotton, silk, flax, wool, and other fibrous substances.*"—July 21; four months.

John White Welch, of Austin-Friars, merchant, for "*an improved reverberatory furnace to be used in the smelting of copper ore, or other ores which are or may be smelted in reverberatory furnaces.*"—July 21.

Frederick Theodore Philippi, of Belfield-hall, calico-printer, for "*certain improvements in the production of sal ammoniac, and in the purification of gas for illuminations.*" (A communication.)—July 21.

William Ward Andrews, of Wolverhampton, ironmonger, for "*an improved coffee pot.*"—July 21.

William Newton, of Chancery-lane, civil engineer, for "*certain improvements in machinery for making pins and pin nails.*" (A communication.)—July 28.

Anthony Bernhard Von Rathen, of Kingston-upon-Hull, engineer, for "*improvements in high-pressure and other steam-boilers, combined with a new mode or principle of supplying them with water.*"—July 28.

Anthony Bernhard Von Rathen, of Kingston-upon-Hull, engineer, for "*a new method or methods* (called by the inventor, 'The United Stationary and Locomotive System') *of propelling locomotive carriages on railroads and common roads, and vessels on rivers and canals, by the application of a power produced or obtained by means of machinery and apparatus unconnected with the carriages and vessels to be propelled.*"—July 28.

ERRATA.

Sir—In my communication on "*Slopes in Sidelong Ground,*" in this month's (July) Journal, page 220, you will find the following misprints, which you will perhaps have the kindness to notice in your next publication.

For $(w \tan \beta - F L) = C F$, read $(w \tan \beta + h) = C F$.

For $C D = (w \tan \beta + h) \frac{\sin C F D}{\sin C E F}$, read $C D = (w \tan \beta + h) \frac{\sin C F D}{\sin C D F}$.

For $C E = (w \tan \beta + h) \frac{\sin C F D}{\sin C D F}$, read $C E = (w \tan \beta + h) \frac{\sin C F D}{\sin C E F}$.

For "therefore the angle $C D F$ will be constant," read "therefore the angle $C F D$ will be constant."

W. R.

In the review of Windsor Castle the following errors of the reviewer were passed unobserved until after the article had gone to press.

Page 278, col. 2, for Edward *the Third* called the Confessor, read Edward *the Confessor*.

In the 2nd paragraph, for Henry *III* read Henry *I*.

Page 279, col. 1, 3 lines from the bottom, for Henry 7 read Sir Reginald Bray. And in the last line, for *his* read *Henry VII*.

TO CORRESPONDENTS.

Mr Barrett's *and* Mr. Brooks' *communications must stand over until next month; also the communications from* S. L. *and* D. C. *We must beg of our correspondents to excuse us in postponing any articles of controversy.*

"A clear fire." *In our opinion his scheme is not practicable.*

"On the forms and proportions of steam vessels," *was received as we were going to press; it will appear next month.*

Two communications on long and short connecting rods are in type, but must stand over until next month for want of space.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

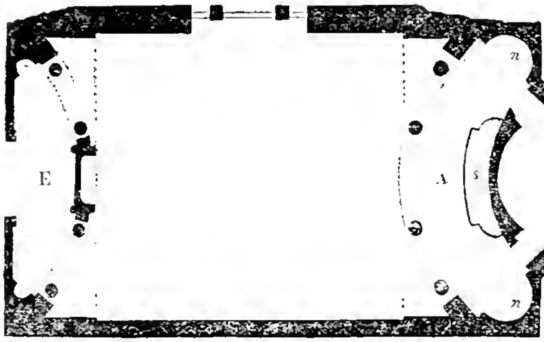
Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

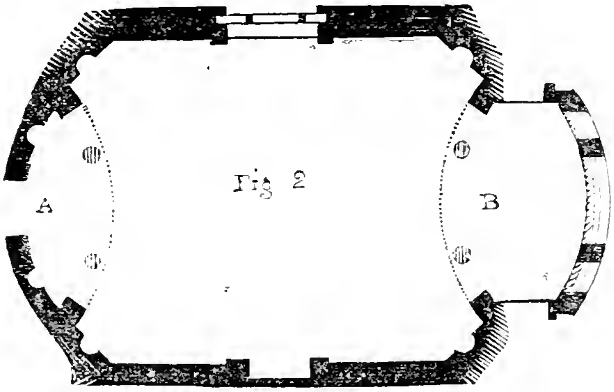
EPISODES OF PLAN.

(Continued from page 143.)

We should be less embarrassed by the extent and complexity of our subject, could we command an unlimited number of cuts to illustrate it; but being under the necessity of observing economy in that respect, and to confine ourselves to *floor-plans* alone, without attempting to show anything further, we experience no little difficulty in determining what sketches to give in preference, out of the ample stock of our materials. Under such circumstances it will perhaps be expected that we should select such as bear the least resemblance to each other; yet, by so doing, we could not show how the same leading idea may, by some slight modification of it, be so altered as to produce a room of quite different character. Which last consideration induces us to give a second plan for a dining-room, bearing a strong resemblance to the preceding one in its general shape and arrangement, yet greatly varied from it with respect to many other circumstances. Therefore, in order that the two may be more conveniently compared together, we will here again introduce the first one, which was but indifferently printed when originally given.

Fig. 1.



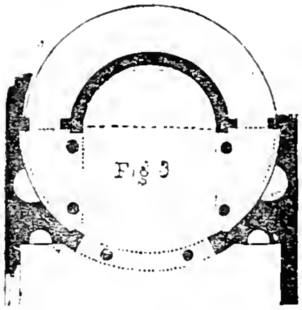


Owing to the peculiarity or singularity of both these ideas, the resemblance between them will probably be thought far more striking than the difference, since the second one also shows a room whose ends are convex in plan, and which is otherwise very similarly arranged. The situation here given to the fire-place would be in itself too trifling a variation to call for notice, were it not that it materially alters the character of the whole, by leaving the entrance recess entirely open to the room; and in consequence, the elevation of that end becomes precisely similar to the opposite one, each of them presenting three open intercolumns, formed in this instance merely by a distyle in antis, consequently with two columns less than in the other plan. A more important distinction is that in this second plan the corners of the room are cut off, whereby not only is the somewhat objectionable sharpness of the angles, occasioned in the other instance by the curved ends being brought up to the side walls, avoided, but the proportion which the end elevation bears to the entire breadth of the apartment is also altered. Besides which, four niches, placed diagonally on the plan, are thus obtained, where they would seem to come in with great propriety—conspicuously, but not obtrusively; on the contrary, where they are in some measure required in order to fill up, and give importance to those spaces. For the last assigned reason, niches are likewise introduced into the entrance recess A.

Should it be made an objection that in consequence of its forming two intersecting curves in its plan, the part A would either occasion much space to be lost, or render it difficult to connect this apartment with an adjoining one, it may be got over by converting the curved wall in which the door is placed into a flat one. Such alteration would still leave the rest of the design just the same as before; nevertheless its character would in some degree be affected by it, and that for the worse, if only because the uniformity now kept up, by the smaller recess A being curved both ways similarly to the larger one B, would then be destroyed. How far the circumstance here noticed would create difficulty by interfering too much with the general plan of the house, must depend upon what would be altogether foreign from our present purpose to take into consideration; our object here being merely to suggest new ideas, and bring forward episodical portions of a plan, not to adapt them to plans in general. We leave the particular application of them to others, leaving also those who may care to adopt any of our hints to adapt and modify them accordingly as circumstances may require; for what would be found eligible and convenient enough in one case, would prove exactly the contrary in another A remark to the same effect has, we find, already been made by us, nevertheless it is one that will very well bear to be repeated, as it is likely to be forgotten by others, though it is highly important that it should be constantly borne in mind by our readers.

The sideboard alcove B does not call for much explanation or comment, we shall therefore confine ourselves to saying that the same accommodation is here afforded as in the first plan, namely an entrance into it for servants. Though two doors are shown, one of them would be sufficient for the purpose, and the other might either be a sham one, or should the plan allow of its being done, might be made to lead to a strong closet for containing the more valuable articles of plate, and also a small retiring closet, &c. The window in this alcove is supposed to be at a considerable height from the floor—eight or nine feet—as the sideboard would be placed beneath it; and it is intended merely to obtain some light from a back court or area, for which reason it should have coloured or ground glass, but merely of such hue as would be sufficient to correct rawness of effect, and throw a sunshiny glow into that end of the room. Though it is differently represented in the cut (fig. 2), it would perhaps be better to confine this window to what now forms its centre compartment (corresponding in breadth with the centre intercolumn of the alcove), treating it as an oblong transparent panel, slightly sunk in the upper part of the wall.

We will now submit another idea professing to be no more than a variation of the alcove capable of being adapted to either of the preceding plans; for which reason it is unnecessary to show the whole of the room in the cut.



In this instance the alcove is greatly extended as to depth, more especially as compared with that in fig. 1, from which, indeed, it is altogether dissimilar, because there not only is the recess considerably shallower, but its back wall is curved convexly, and concentrically with the elevation towards the room. At the same time it resembles fig. 1, in so far as it occupies the entire width of the room; but then again, such resemblance is attended with a very material difference, inasmuch as in fig. 3, the alcove is more enclosed, so that it seems to expand itself within, as viewed through the external columns. The same may be said of it, if it be compared with fig. 2, that being a simple recess merely divided off from the room by columns, and no wider within than its opening towards the room.

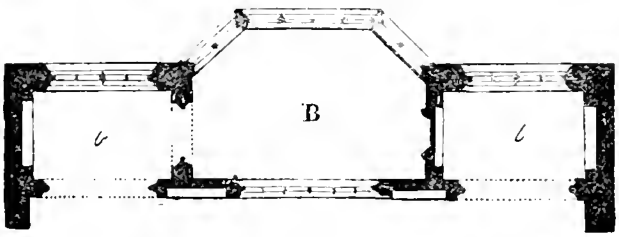
Fig. 3, on the contrary, affords an example of what may very well be distinguished by the name of a *compound* recess,—and also of what many will, no doubt, be apt to consider a strangely fanciful—not to say fantastical, arrangement. We certainly cannot produce authority for any thing of the kind, because we do not recollect, and therefore may safely affirm that we have never met with any similar instance. If others choose to say, it ought on that very account, to be received with a good deal of suspicion, they are certainly at liberty to do so—or for that matter, to reject our ideas and opinions altogether.

Capricious as it may at first sight be considered, this alcove (fig. 3), will, we think be found, on examination, to be well motived and commodious in plan. While the inner columns would produce great richness of effect—would render the whole a striking architectural picture; they serve also to define the central space, to keep that part more distinct from the rest, thereby giving more importance to that, and by screening off the spaces behind them, to convey the idea of the alcove's being greatly extended by the addition of these last. Nor is it in such respect alone that the plan belongs to the class we would distinguish as compound, since such character is still further increased by the addition it receives from the part *s*, which is here made to form a second or inner recess where the sideboard would be placed, and which therefore should be allowed to show itself distinctly as such by being treated as a large niche, or else covered with a semidome carried up above the ceiling of the alcove and room. In the last mentioned case, that recess might be lighted from above through its dome, nor would other light be then required; should that however, not be practicable, and should an arched niche-like recess also be objected to for the design, it would then be better to contract the space *s*, reducing it from a semicircle to a more shallow recess whose curvature would be *anti-concentric* to, and therefore correspond with, that on which the columns facing it are placed,—as is done in the recess B, fig. 2.

Almost any one of these three plans above will be found, if studied for that purpose, to contain within itself the germs of many others; and notwithstanding that they possess something in common—taking them altogether they furnish more variety, as far as plan is concerned, than is now to be met with in as many thousand examples,—which however they may differ as to matters of decoration and detail are nearly alike in regard to arrangement and plan.*

Instead of proceeding, as we could easily do, with other plans of the same class, and for similar purposes, we will, by way of change, now exhibit one for the window side of a library, occupied entirely by three bays. In order both to obtain novelty of character, and increase picturesque

Fig. 4.



effect, the larger bay B, in the middle, is converted into a sort of case separated from the rest of the rooms, by an open screen with tracery, and carried down to about three feet from the floor. This screen, which might either be glazed or not, as should seem most expedient, would not only be characteristic and ornamental in itself, but be rather serviceable than otherwise, by moderating the light within the body of the room, and thereby rendering the two open bays, *b b*, more piquant and brilliant by contrast. In fact the plan would admit of the lower part of the screen being closed up to the height of about six feet from the floor, by which means additional space for book-shelves, on one if not both sides of it, might be obtained. And although this would materially diminish the light in that part of the room, little if any inconvenience would result from that circumstance, because it is here supposed that the room itself is chiefly intended to contain books, and that the cabinet B, and the two bays *b b*, would be for sitting in. Accordingly the fire-place is put within B, as the most convenient situation; and as that one would be sufficient, the space that must otherwise be occupied by a chimney-piece and chimney pier would be left free for book-cases or shelfing.

With the same plan, a room of very different appearance as to design, if not exactly as to character, might be produced by merely transposing the situation of the enclosed and open portions,—that is by removing the screen between B and the room, and in lieu of it, screening off the two lesser bays *b b*, which might either immediately communicate with, and be open towards the larger bay, or entirely shut up from it, as one of them is shown in the cut. In the former case a vista would be obtained through the three bays, by a compartment at each end filled with a mirror, so as to give the effect of an open arch; or else instead of being filled with a single mirror, each of those compartments might be divided into panels by mullions, &c., like those of the screens, whereby the effect of an additional open screen in each of the smaller bays, might be obtained.

As our chief object is rather to afford suggestive hints, than to give plans definitively fixed, and intended for some one individual case, we do not pretend to enter into more exact description. The cut itself too, must likewise be received as a mere explanatory sketch, it being on too small a scale to admit of nicety as to detail, or do more than indicate the arrangement and principal forms.

(To be continued.)

* Should this be disputed, we should feel obliged to any one who would inform us what remarkable instances of the kind there are which would tend to support an opinion contrary to that here expressed.—Ed.

ON THE CONSTRUCTION OF OBLIQUE ARCHES.

Sir—I am sorry to trespass again on your pages in reference to Mr. Peter Nicholson's work on Railway Masonry, but having a few days since been made aware that a second edition of his book was published, in which a reference was made to some remarks I had previously written in your Journal, I procured a copy of it, and the reference in question being nothing more or less than a gross misrepresentation of facts, I trust you will allow me space to set the matter in its proper light.

The point in dispute is relative to Mr. Nicholson's trihedral system. In his first edition he says at page xxiii, "If a trihedral be cut by a plane perpendicular to one of its oblique edges, the section shall be a right angled triangle." Relative to this I made the remark that there were three sorts of trihedrals, and that this assumption only holds good with one of them, namely, a right trihedral.

In his second edition, page xxix. A, after stating that the trihedral there treated is a right trihedral, he says, "if *such* a trihedral be cut by a plane perpendicular to one of its oblique edges, the section shall be a right angled triangle." To the end of which he appends the following complimentary observation. "I have called this kind of trihedral a right trihedral; but a narrow-minded hireling, who signs himself W. H. B., in the Civil Engineer and Architect's Journal, page 152, has erroneously transcribed from a paragraph following, Def. 6, page xxiii., Railway Masonry, first edition, 'If a trihedral be cut by a plane perpendicular to one of its oblique edges, the section shall be a right angled triangle,' leaving out the part that would make sense. His remarks, founded on this mistranscription, resemble rather the puerilities of childhood, than the reasoning of mature age."

Setting aside his personal abuse which will neither benefit his position nor injure mine, the reply I have to make to the rest of his observation is, firstly, that in saying I have mis-quoted his work, he deliberately states that which he knows to be untrue; and there stands the paragraph at page xxiii., of the first edition to prove it.

Secondly. In saying I omitted the part that made sense of the passage, he accuses me of the very blunder he himself committed, of which the fact of his having corrected himself at page xxix. A, of the present edition, is abundant evidence.

The fact is, the page (xxix. A) is a fresh page which he has added to his book, for the express purpose of inserting the corrected paragraph; and has attached my remark to the corrected paragraph, declaring it to be a misquotation. It is really very lamentable to see a man of the standing Peter Nicholson once had, obliged to have recourse to so mean and unworthy a subterfuge; and it is still more lamentable to see him forget himself so much in the language he makes use of. I consider it to be the duty of every one who is in a position to do so, to expose the errors of a work addressed to the public; particularly when it comes from the pen of one who has enjoyed a considerable portion of their confidence and support, and is addressed to those classes who being unable to investigate the subjects contained in it for themselves, are compelled to rely implicitly on what is given to them by the author. With this view I made my remarks on Mr. Nicholson's first edition, and with this view I now proceed to show that a great deal yet requires alteration in the second.

Taking for example page 7, he says, "in order to prevent two joints from meeting each other, it is necessary that the number of arch stones in each face should be an odd number." Now every body at all ac-

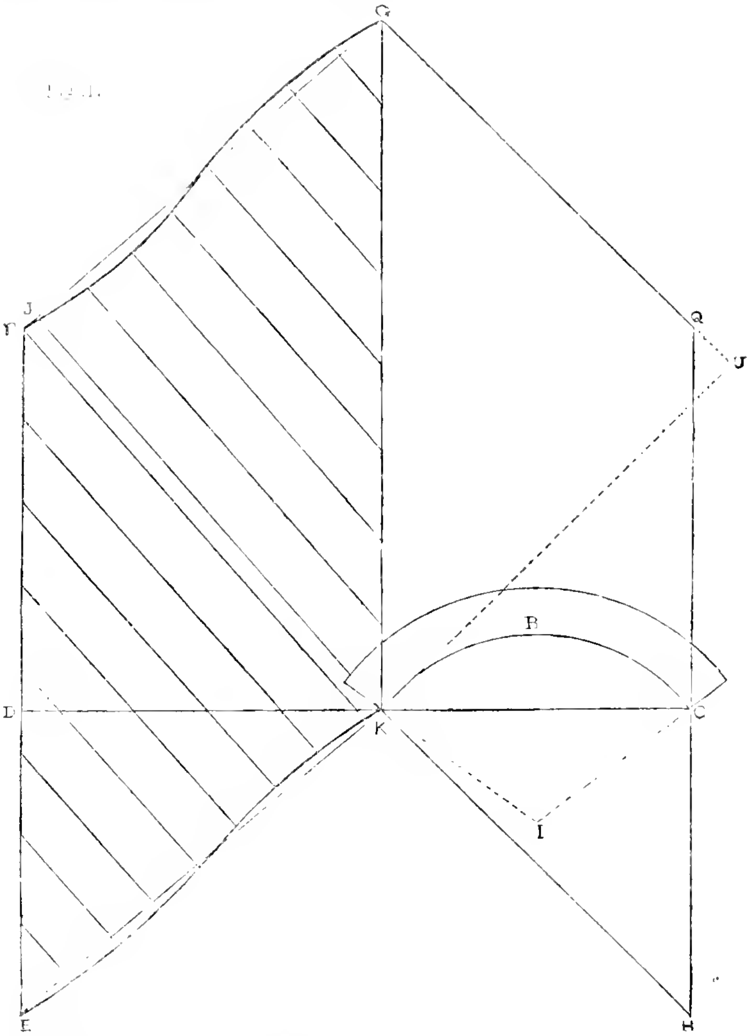


Fig. 3.

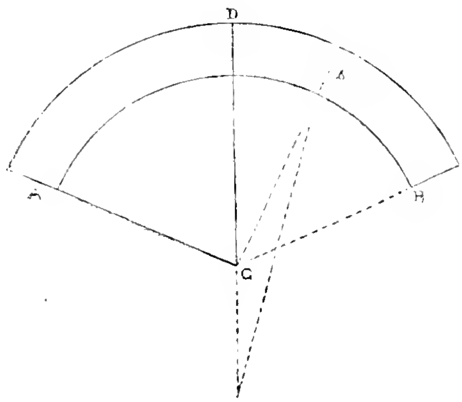


Fig. 4.

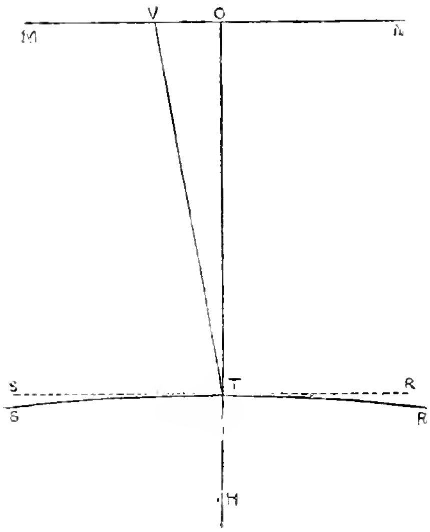
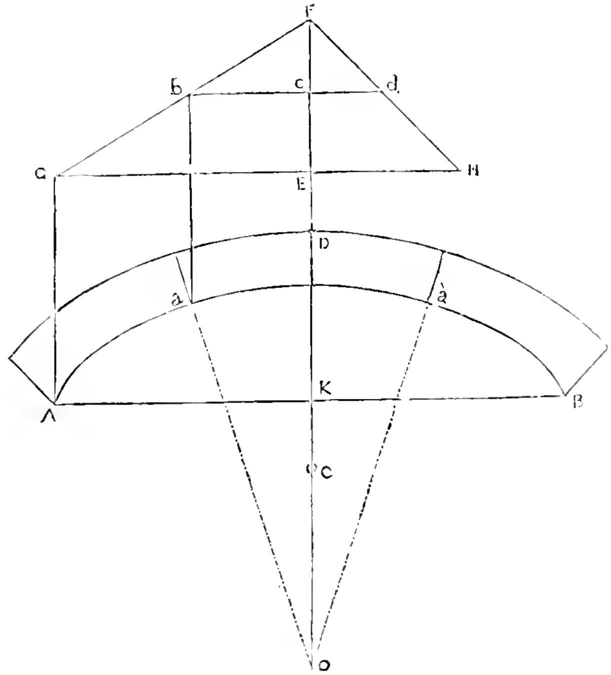


Fig. 2.



quainted with the subject knows that the number of courses being odd or even has nothing at all to do with the meeting of the joints.

Next, (referring to the same page), about dividing the line E A, fig. 1, we will here take a figure with his own letters as example, Suppose it was required to construct an oblique arch of the following dimensions, viz.:

Span 10 feet = A C.
Rise 2·5 feet.
Angle of obliquity 45° = A H C.
Width of bridge 16 feet = A u.

And take the case he does at page 7, in supposing the number of courses to be nine; following out the directions given by him, namely, to draw F K to meet the straight line A E perpendicularly in K, E K will be divided into eight courses, and A K will be the ninth; *which would require eight courses to be 1 foot 10·17 inches thick, and the remaining one to be 6·36 inches thick.* Now I would ask, does Mr. Nicholson really come forward with such a rule as this, and call his book a *Guide to Railway Masonry?* Is he ignorant of the fact that Mr. Buck has surmounted this difficulty by the simple expedient of adjusting the angle of intrado—or is it that, rather than acknowledge his inferiority, he persists in what he knows to be wrong, and addresses his book to the working classes in the hope of escaping detection?

Again, with reference to obtaining the angles between the joint lines in the face and in the soffit of the arch. It is perfectly distressing to see a problem which admits of easy solution so miserably mutilated as it is in his hands. The construction given by him, that is to say the only one that deserves the name of an approximation, occupies two and a half closely printed pages of his book, while these angles may be obtained with much greater accuracy, and with about a quarter of the labour as follows. Let A D B fig. 2 be the elliptical face of the arch, and O the point to which the joints in the face converge (see Buck on Oblique Bridges); produce O D to F any convenient distance, and make F E = half the obliquity of the arch. Draw G H parallel to A B, set off G E = A K, join G F, and draw the line F H, making the angle E F H equal the angle of extrado.

Then to find the curved bevel for any joint a, join $a\ o$, and draw $a\ b$ and $b\ d$ respectively parallel to O F and G H. Take two lines $m\ n$, $o\ h$, at right angles to each other, as at fig. 3, set off $o\ v = d\ c$, fig. 2, and from v, with a distance equal to $a\ o$, fig. 2, describe an arc intersecting $o\ h$ at t. Then applying the mould of curvature of the spiral line of the intrado $s\ t\ r$, so that the line $s'\ t\ r'$ drawn at right angles to $o\ h$, is a tangent to the curve at the point t; the angles $s\ t\ v$ and $r\ t\ v$, are the bevels adapted for the joint a, fig. 2, and the corresponding joint a' on the other side of the arch. With this construction the angles for all the joints may be obtained from fig. 2, without any confusion in the figure.

These angles may also be obtained by computation, for let A D B, fig. 4, be the elevation of the arch on a plane at right angles to the axis of the cylinder, and C be its centre, and let a the position of any joint be given. The angle D C a being then known,

If the angle D C $a = \lambda$,
Angle of obliquity of arch $= \theta$,
Angle of extrado $= \varphi$,
And the radius of the cylinder $= r$.
Let r (cot. θ, sec. φ) $= a$,
And r (cot. θ, tan. φ) $= b$,

*Then $\dfrac{a\ (\text{sin. } \lambda)}{(b\ \text{cos. } \lambda) + r}$ = tangent of the angle $v\ t\ o$ fig. 3.

An oblique bridge however is not necessarily built of stone, nor has it always stone faces. Yet Mr. Nicholson would have the same interminable process gone through in every case, while if the arch be entirely of brick, and the span, the angle of obliquity, and the radius are given, all that is required for the workmen is the angle of skew-back, and the length of the check on the impost, which are at once obtained as follows:

Let θ = angle of obliquity,
s = square span,
a = length of arc,

$\dfrac{(\text{cot. } \theta)}{a}\ s = \text{tan. } \beta$, the angle of skew-back, and (cosec. β) 3 = length of the check in inches, 3 inches being the assumed thickness of a course of bricks. The length of the check thus obtained may be either adjusted so that each extremity of the impost coincides with the extremity of a check, or retaining the computed length of check, they may be so placed on the impost that the springing shall take place at the same elevation on both sides of the arch. After which if the courses are properly gauged on the centre, and the course lines drawn down to their respective checks, no mistake can arise in laying the bricks.

Mr. Nicholson's rules however are not only very unnecessarily tedious, but it would appear by his own showing, that they are not over certain in their results. In a note at the bottom of page 22, in reference to a model made by the joint assistance of two masons, a joiner, and Nicholson's Guide to Railway Masonry, he says, "N.B. the model here alluded to has only 16 spiral courses, although 17 were intended. However, the calculations in all the principal parts will remain the same." One course too many in sixteen is not much certainly, but in these economising times it is just as well, considering that it is just as easy to know before hand how many courses there are to be in a bridge. In whatever way however the alteration of the number of courses was produced, one thing is clearly showed by it, namely, the fallacy of his assertion at page 7, respecting the necessity of having an uneven number of archstones in the face.

As for all that part of his book which contains such problems as the following, viz.: "Given the three sides of a triangle to construct the triangle," and "from a given point near the middle of a straight line to draw a perpendicular;" it is, to say the least of it, most arrant twaddle. He might with equal propriety have added, given a pair of compasses with a point at one leg and a pencil at the other, to describe a circle.

However, I will say no more. For this time I have, as he observes, "done with him;" and I hope enough has been said to show Mr. Nicholson that his ideas have got a twist in their beds by no means adapted to skew-bridges, and that no species of brow-beating or invective on his part will be of the slightest use to him, while his book remains so very imperfect.

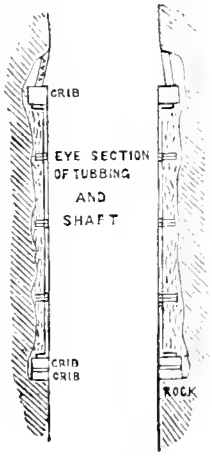
I am, Sir, your obedient servant,
W. H. Barlow.

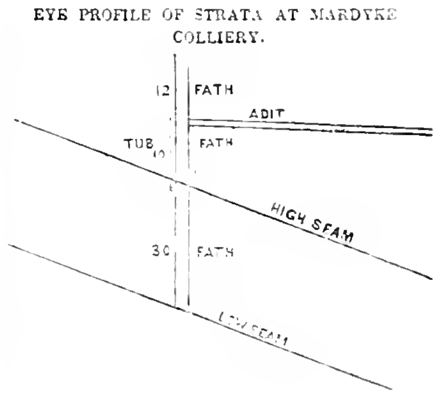
Brenton, August 16, 1841.

* The mode of obtaining the formula and construction is too long for insertion in this letter, but I will supply it if required.

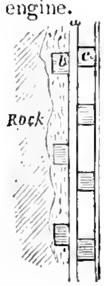
CAST IRON TUBBING.

In the Mining Journal there are some useful communications on Engineering Works connected with Mining, from which we select the following on "Tubbing of Shafts:" the first description is the application of a cast-iron tub, for the stopping back of water at Mardyke Colliery, the property of the Irish Mining Company, by Mr. Dunn, of Newcastle-on-Tyne, the first attempt in Ireland. The colliery contains two principal seams of coal, lying at an angle of one in three. The upper one, lying at the depth of 22 fathoms, is exhausted; and in order to win the second seam, at the depth of 30 fathoms further, the waters of the upper seam were required to be either pumped up to the natural adit (12 fathoms from surface), or to be forced up to that





point of discharge by tubbing. In order to give this project a fair chance, a piece of fire-clay, lying below the first seam, was taken advantage of as a foundation, and the shaft was rounded out to ten feet diameter. The base of tubbing is made to rest upon a pair of oaken cribs, fitted closely to the fire-clay foundation, and wedged from behind as long as ever a wooden wedge can be driven. This done, the cast-iron tub begins to be built, consisting of cast iron segments, four feet long, two feet high, and three-quarters of an inch thick, with a rectangular flange all round, of three inches; between each of these segments are placed half-inch (end ways) fir deal, wherein to wedge; the space between the segments and the rock is also stuffed with small stones, and tightened with wood. The top of the segments was completed by a wooden crib, which was stayed fast against the superincumbent rock, and then the whole fabric underwent the most severe wedging so long as any leak continued; and, when finished, the shaft was laid perfectly dry, with the feeder of water discharging out at the adit 12 fathoms above, and the sinking of the shaft resumed perfectly dry. The pressure against every square inch of the lower range of tubbing is equal to two and a half atmospheres, or about 37 lb. per inch, and, taking the average altitude at 36 feet, the whole tub is sustaining a pressure of about 81,200 tons; and so complete is the job, that the sinking has been since carried on without any pumping apparatus, whilst sufficient water is discharging at the adit as would give employment to a heavy engine.



It is often found convenient to surmount these tubs with a sufficient quantity of stone walling, to enable the wedging to be made effective.

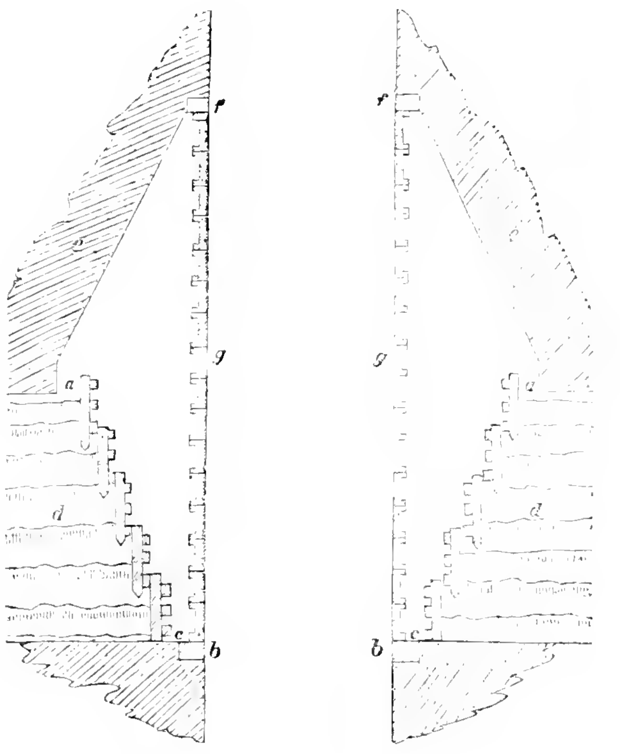
Some years ago Mr. Dunn effected the "winning" of a shaft, 30 fathoms deep, at Castle Comer, in the same county, by means of a plank tubbing, of 10 fathoms in length, constructed of three-inch planks, a, spiked against wooden cribs, b, and supported again by a range of inside cribs, c, which were in their turn clead with common deals; this mode of stopping water was practised for many years previous to the invention of cast iron tubbing.

ACCOUNT OF SOME PLANS ADOPTED IN THE NORTH OF ENGLAND OF SINKING THROUGH QUICKSAND.

By EDWARD STANLEY, Engineer, Sunderland.

When a "winning" numbers amongst its contingencies an encounter with a formidable quicksand, the preparations are, or ought to be, well digested as to power and appliances to overcome it. The viewer, engineer, and master sinker, each in their respective departments, take a retrospect of the means used on former occasions at other places, selecting the improvements that each adopted from previous works, which give every new "winning" an opportunity of profiting by the experience of the past. Boring by rods having determined the distance the sand is situated from the surface, and also the thickness of the sand previously; this operation is requisite, as the pit has to be chambered or bevelled like the frustrum of a cone, for the purpose of driving the spiling and laying cribs, each length and round in the descent being within the previous one. Supposing, for instance, the pit is 15 feet diameter, and the sand five fathoms, or 30 feet, in depth, and the spiling and cribs averaging each six inches thick, and the length of the spiles six feet, it remains now to examine what must be the diameter of the base of the frustrum of the cone, bevelled out so as to have the pit of sufficient size at the bottom of the sand as to admit the metal tubbing, and preserve the size of the pit. It will be, of course, premised that in six feet lengths it will require for the 30 feet, five lengths; if fewer lengths could be driven through the sand, the less the frustrum of the cone bevelled out in the rock; but long lengths, when driven, if the deviation is small, are like the trifling inaccuracy of an angle, which, if produced, are a long way out at the far end; it is, therefore, advisable to keep the lengths short, and in the annexed diagram are five. The five rounds of spiles and cribs, according to the former dimensions, will take up 10 feet of the diameter of the pit. We must add a clear space round at the surface of the sand, *a a*, of 18

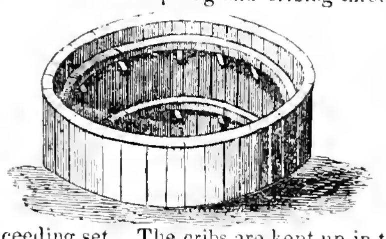
Fig. 1.



inches, which will add to the former diameter three feet, making it 13 feet. Further, we have to add the breadth of wedging crib, *b b*, cut at the bottom, and the space between its outer circumference and the lowest crib of the last spile, *c c*, together two feet each, which, added again to the 13 feet, makes 17 feet. This summary is the extra diameter over and above that of the pit, which we took at 15 feet, which gives 32 feet as the diameter of the base of the frustrum of the cone.

The height of this frustrum will depend upon the soundness of the limestone in contact with the sand. If not very sound, it must be carried further up, both for the safety of the sinkers and efficiency of the wedging crib at the top of the tub. The stratum of quicksand is shown by the letters *d d*, and the superincumbent limestone, *e e*, the top, or closing crib, *f f*, and the metal tubbing, *g g*; the manner of putting in which is by an intervening layer of deal sheathing, at the vertical and horizontal joinings, and subsequent wedging, has already been given in the *Mining Journal*. No letters of reference are put to the spiles and cribs, as they will easily be recognized, each spile having three cribs, at a distance apart of about two feet.

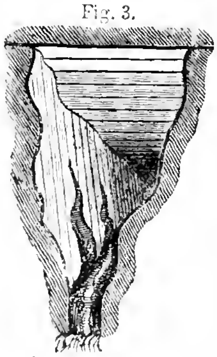
The following figure in perspective may give a more general idea of the mode of spiling and cribing through the sand:—It will be perceived that the spiles are driven round the pit in the sand, and considerable attention and care is required on the first round—and the reason is, that when it is accomplished, and the three cribs inserted, the last of these acts as a guide for the circular insertion and driving of the succeeding set.



The cribs are kept up in their proper position by cleats or brackets (see fig.) till a sufficient external pressure keeps them tight. The spiles may be lighter near the surface of the sand if thought proper, and increase in thickness in the succeeding lengths with the pressure, but some consideration should at the same time be made for the large diameter requiring increased strength. It may, therefore, be considered a prudent error to be too strong instead of too weak. A bird's eye view of the spiling, when complete, presents in principle an analogy to the elongation of a telescope.

It may appear paradoxical to a person unacquainted with the district, to be told that the quicksand sometimes presents itself in the form of a hard rock, requiring the liberal use of gunpowder to detach it. This stone is very porous, through which immense quantities of water filter, and which, by a continuous, running, increase the size of the apertures, along which are at the same time conveyed a large quantity of sand to the pit. This result is technically called "guttering," and, on any cessation of pumping, and consequent rising of the water, it increases to a great extent. As the water is being drawn out of the pit, its receding from the gutters brings along with it sand, and hence their enlargement.

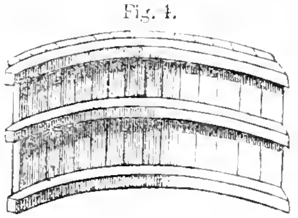
Fig. 3.



The annexed fig. shows a gutter fallen on to the limestone roof. At the bottom will be perceived a stream proceeding from the far end, having tributary ones from each side. These, in some cases, keep filling up the bottom of the pit with sand, nearly as fast as it can be sent to bank. With a sand of this kind, the general aim is, to keep the water always down if possible, for it has been found that its rising invariably increases this guttering, which proceeds in long irregular chasms radiating from the shaft.

As "spiling" cannot be driven under circumstances of this kind, the cribbing and lathing is put into the pit in sections, as shown in the annexed fig., varying in depth according to circumstances, and as the sand can be excavated. These sections, when the round is complete, are kept together vertically by hanging deals, which are planks spiked to the previous rounds, or if it be the first round, to some suitable provision in the shaft; external pressure soon binds them horizontally. In some cases the sand becomes soft towards the bottom, and the sections are abandoned for spiling.

Fig. 4.



The foregoing details are enumerations of the resources hitherto applied, which appear, and, indeed, have been found in practice to answer best. In cases of difficulty, parties having works of this kind in hand are frequently favoured with friendly suggestions, the most popular of which appears to be the suspension of a cylindrical iron vessel, of proper diameter, which it is proposed to lower and lengthen at the top as the excavation proceeds. This suggestion has certainly feasibility about it, though it is said to have originated from an amateur.

The present article may not inaptly close with a brief notice of the Datton "winning," which is going on slowly but surely. The most determined and persevering spirit is shown by the owners (Messrs. T. R. G. Bradyll and Co.), and the viewer. The outlay of money is immense, and the conviction is, that the colliery will be eventually "won." The engine power is ample, cancelling accidents, which have not been frequent. The settling of the sand on the bucket on one occasion was so dense as to be the means of lifting a column of 33 fathoms, of 22-inch pumps, by the spears on the starting of the engine. The sand is hard, and the feeder flowing principally from the south, has occasioned great delay and expense by guttering. Fig. 4 is a representation of the wooden segments that are being put in to get through the sand previous to metal tubbing, which is now about half penetrated. The liberality and public spirit of the owners deserves the most complete success, which all parties earnestly wish may be the case.

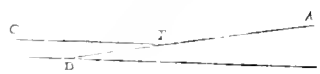
Another "winning" is now being made at Shotton, belonging to the Haswell Company, under the management of Mr. Thomas Foster, where the quicksand is very nearly arrived at. Should "any thing fresh" be brought into play at this place, either in getting through the sand, or the surface arrangements, it will appear in the Journal, with suitable illustrations, so far as it can be done without injury to the proprietors.

DREDGE'S SUSPENSION BRIDGES.

Sir—May I request the favour that the following remarks (on an anonymous communication, signed G. F. F., which appeared in your last Journal), may be inserted in your next.

The curve of a taper chain either connected or unconnected with the platform, is not a catenary, but one of very different properties; it might be easily demonstrated, but let that pass—for your correspondent makes as great a mistake in regard to the action of the oblique suspending rods in connection with the chains, and which is the only part of his letter I shall notice.

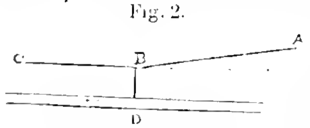
Fig. 1.



C, the centre of the bridge.

Let A B C represent a portion of the chain of a suspension bridge, B D an oblique suspending rod having the same inclination with the horizon as that portion of the chain B A; then will the strain upon B D, and of course upon B A, be proportional to the secant of the angle D A makes with the horizon, and there being no resolution of forces from the point B, there can be no tension in the direction B C.

Fig. 2.



C, centre of the bridge.

Again, put A B C part of the chain of a common suspension bridge, B A forming the same angle with the horizon as A D did in the former curve; then will the strain in the direction B A be proportional to the secant of the angle which it makes with the horizon (or the same as before), but by a resolution of forces, there would be a tension in the direction B C, α as the radius, which tension must be borne by a sufficient quantity of iron, and that iron causing a strain on the curve α as the secant of the angle B A makes with the horizon.

I shall take no further notice of this anonymous communication, but if your correspondent wishes further information, he must affix his name to his next letter, and then be careful what he says, for though the diagram he shows is totally different from the form proposed, his demonstration if carried out, would only tend to support that principle he is attempting to refute, and the several structures either in course of, or about to be erected in various parts of the kingdom, will at once silence every futile objection that can be raised against it.

I remain, Sir, your humble obedient servant,

J. Dredge.

Bath, August 16, 1841.

P.S. I would refer your readers who may be interested in this subject, to the drawings which have appeared in your Journal, and they will at once perceive that there is not the slightest similitude between them and that represented by your correspondent in the last number.

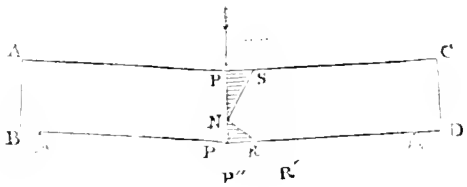
*** We know not what right Mr. Dredge has to make the insinuation which he has done in the above letter, with regard to an "anonymous communication." The article of G. F. F., was written without the slightest taint of presumption or slur upon Mr. Dredge's invention, it was a fair scientific enquiry into its merits, and such a one as every inventor must be ready to encounter, if he be desirous of introducing to the scientific world any new form or invention. For the purposes of free and open discussion, we do not see the necessity of correspondents giving their names—and we shall leave it to G. F. F. to reply to Mr. Dredge's remarks.—Editor.

ON THE TRANVERSE STRAIN OF BEAMS.

By Herbert Spencer, C.E.

The following paper is an outline of a new system of investigating the laws of the transverse strain, differing from the usual method, in as much as it depends solely upon the position of the neutral axis. The results as here given, will probably not be considered sufficiently concise for practical application; but they are published in the hope that something useful may be elicited.

Fig. 1.

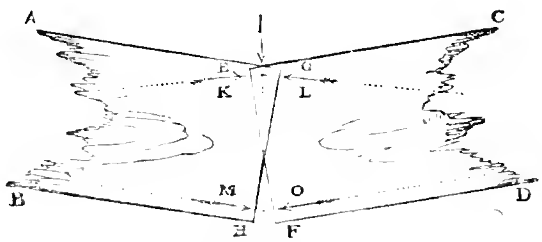


1. Let A B C D be a piece of timber, subject to the transverse strain in the direction shown by the arrow; and let P P′ be assumed as the plane of fracture, and N the position of the neutral axis. Take any line P′ R, to represent the resistance to fracture of all the fibres in the bottom lamina, then by the theory of the lever, if N, R, be joined, and any line be drawn parallel to P′ R, and terminated by N P′, and N R, it will represent the relative effect of all the fibres in its latitude, and therefore the whole triangle N P′ R, will denote the resistance to fracture of all the fibres in tension. In the same manner, a triangle N P S may be assumed, which shall represent the resistance of all the fibres in compression.*

2. Now the mode of action of the fibres in resisting the force impressed, involves the necessity of the equilibrium of the compressive and tensive resistances, about the transverse line through N, that is the neutral axis; for suppose a saw-gate made down the line P N as far as N, and the force to be then applied; a deflection will immediately take place, and the surfaces of the opening will come into close contact. Carrying out the idea it would appear, that the deflection would continue, until the resistance to compression in the upper portion P N of the plane of fracture, is equal to the resistance to tension in the lower portion; or that in the uncut beam, the neutral axis arranges itself so that these forces are in equilibrium.

As it is this theory upon which all that follows depends, and which if disproved, will invalidate the succeeding calculations, it may be well to give a further illustration.

Fig. 2.



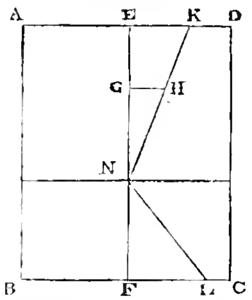
Let A B C D be a piece of wood as before, subject to transverse strain, and let E F and G H be the planes of fracture; (the diagram being necessarily greatly exaggerated to make the action clear) draw the arrows K, and O, perpendicular to E F, and L, and M, perpendicular to G H; then K, and L, will represent the direction of the resistances of certain fibres to compression, and M, and O, those of the resistances of other fibres to tension; (the forces extending the fibres are acting from H towards B, and from F towards C, and the resistances will obviously be in the reverse directions)—now K, and O, being perpendi-

* This theorem affords a simple demonstration, that the strength varies as the square of the depth; for if the depth be increased, (the neutral axis remaining constant) so that N P′ becomes N P″, the original supposition being carried out, the triangle N P″ R′ will denote the new tensive resistance; but the triangle N P″ R′, is to the triangle N P′ R, as $(N P'')^2$ to $(N P')^2$; that is the resistance of the fibres in tension, varies as the depth square, and the same will be true of those in compression.

cular to E F are parallel, and the same may be said of L, and M; hence if produced they will form a parallelogram, and the resultant diagonal of K, and L, will be equal, and in the opposite direction to that of M, and O; that is, the forces will be in equilibrium; but if K, and L, be greater than M, and O, their resultant diagonal will also be greater, and motion must ensue, that is such a state of things cannot exist. And what is true of these single forces, will be true of the forces of all the fibres collectively; or the resistances to compression and tension will be equal. It may be said that this explanation, involves the necessity of the centre of motion N, being midway between the contending forces, and that that does not obtain, in the case in point; but this does not prevent its application, for the resistances to tension though exercised nearer to the neutral axis, are greater in amount, so that the effect is practically the same.

3. The position of the neutral axis therefore, depends upon the ratio between the tensive and compressive resistances of the material, and by the application of the above principle, with the necessary data, its situation may be found. The next step will be to develop the general expression for obtaining it in simple cases.

Fig. 3.



Let A B C D be a transverse section of a rectangular beam; assume N as the middle of the neutral axis, and through it draw the central line E F, and in F C take any line F L, to represent the resistance of all the fibres in the line B C; join N L, and the triangle N L F will denote the resistance of all the fibres in tension. Make N G, equal to N F, and draw G H perpendicular to it, and let G H, be to F L, as the resistance to compression, is to the resistance to tension in the material in question; join N H, and produce it to K, then the triangle N E K will represent the resistance of all the fibres in compression, and will consequently be equal to the triangle N F L. Let x equal N F, the distance of the neutral axis from the bottom; take d for the depth, and let p and q stand for F L and G H respectively; that is, let them denote the tensive and compressive resistances.

Now by similar triangles N G : G H : : N E : E K,

or $x : q :: d-x$: E K, or $\text{E K} = \frac{q\,(d-x)}{x}$,

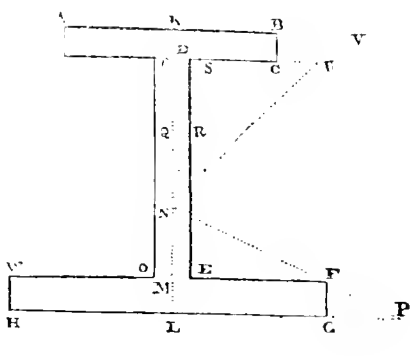
$\therefore \dfrac{(d-x)\times\dfrac{q\,(d-x)}{x}}{2}$ = area of triangle N E K; and $\frac{p\,x}{2}$ = area of triangle N F L; hence we have the equation,

$\frac{p\,x}{2} = \frac{q\,(d-x)^2}{2\,x}$ or $p\,x = \frac{q\,(d-x)^2}{x}$, hence $p\,x^2 = q\,(d-x)^2$ or $\frac{p}{q}\,x^2 = d^2 - 2\,dx + x^2$. dividing by x^2, $\frac{p}{q} = \frac{d^2}{x^2} - 2\frac{d}{x} + 1$ and extracting root

$$\frac{d}{x} - 1 = \sqrt{\frac{p}{q}} \text{ or } \frac{d}{x} = \sqrt{\frac{p}{q}} + 1, \text{ and } x = \frac{d}{\sqrt{\frac{p}{q}} + 1} \qquad (1.)$$

4. The application of the principle to the common form of girder, is the next case that suggests itself.

Fig. 4.



Let A B C D E F G H be the section, assume N to be the middle of the neutral axis, and through it draw the central line K L, and in the line E O, take a line M E, to represent the resistance to fracture of all the fibres between E, and O, and for the sake of convenience, let M E be equal to half E O; join N E, N F, and let N F, and H G, produced, meet in P.

Make N Q, equal to N M, and draw Q R perpendicular to it, and let Q R, be to M E, as the compressive resistance in cast iron, is to the tensive resistance; join N R, and produce it to S, and as T S : T D, so make T U : T C; join N U, and let N U, and A B, produced, meet in V.

Then in accordance with the principles as applied in the last case, the figure N L P F E, will represent the resistance to fracture, of all the fibres below the neutral axis; and the figure N S U V K, the resistance of all those above, and these will be equal.

Now let x = N L the distance of the n. a. from the bottom.

d = the whole depth.
d' = depth of top flange.
d'' = depth of bottom flange.
b = breadth of top flange.
b' = ditto of middle rib.
b'' = ditto of bottom flange.

And as before, let p and q represent M E and Q R respectively.

Then N M : M F : : N L : L P or $x - d'' :: \frac{p\,b''}{b'}$* $:: x$: L P

or $\text{L P} = \dfrac{x \times \dfrac{p\,b''}{b'}}{x-d''} = \dfrac{p\,b''\,x}{b'\,(x-d'')}$. Therefore the area of the figure N L P F E will be represented by,

$$\frac{p\,(x-d'')}{2} + d''\left(\frac{\frac{p\,b''}{b'} + \frac{p\,b''\,x}{b'\,(x-d'')}}{2}\right) =$$

$$\frac{p\,(x-d'')}{2} + \frac{p\,d''\,b''}{2\,b'} \times \left(1 + \frac{x}{(x-d'')}\right)$$

Again, as N Q : Q R : : N T : T S,
that is $x - d'' : q :: d - d' - x$: T S,

$$\text{or T S} = \frac{q\,(d-d'-x)}{x-d''}.$$

But T D : T S : : T C : T U or $p : \frac{q\,(d-d'-x)}{x-d''} :: \frac{b\,p}{b'}$† : T U

$$\text{that is T U} = \frac{\dfrac{b\,p\,q\,(d-d'-x)}{b'\,(x-d'')}}{p} = \frac{b\,q\,(d-d'-x)}{b'\,(x-d'')}.$$

And N T : T U : : N K : K V or

$$d - d' - x : \frac{b\,q\,(d-d'-x)}{b'\,(x-d'')} :: d - x : \text{K V},$$

$$\text{hence K V} = \frac{\dfrac{b\,q\,(d-d'-x)\,.\,(d-x)}{b'\,(x-d'')}}{d-d'-x} = \frac{b\,q\,(d-x)}{b'\,(x-d'')}.$$

And the area of the figure N S U V K, will therefore be represented by

$$\frac{d-d'-x}{2} \times \frac{q\,(d-d'-x)}{x-d''} + d'\left(\frac{\frac{b\,q\,(d-d'-x)}{b'\,(x-d'')} + \frac{b\,q\,(d-x)}{b'\,(x-d'')}}{2}\right)$$

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* As $\frac{b'}{2}$ represents the resistance of all fibres between O and E; $\frac{b''}{2}$, will denote that of all those between W and F; and $(\frac{b''}{2} \div \frac{b'}{2})$ that is $\frac{b''}{b'}$, will express the multiple, that the number of fibres between W and F, is of the number between O and E, and if p equal the resistance of fibres between O and E, then $p \times \frac{b''}{b'}$ will equal that of all fibres between W and F. It is necessary that the quantity should be put in this form, instead of the simple fraction $\frac{b'}{2}$, in order that the value of L P, should involve the term (p).

† The last note explains this also.

But, area N L P F E = area N S U V K.

Hence we have the equation,

$$\frac{p\,(x-d'')^2}{2}+\frac{p\,d''\,b''}{2\,b'}\times\left(1+\frac{x}{(x-d'')}\right)=\frac{q\,(d-d'-x)^2}{2\,(x-d'')}+$$

$$\frac{q\,d'\,b\,(2\,d-2\,x-d')}{2\,b'\,(x-d'')}.$$ And multiplying by $2\,(x-d'')$,

$$p\,(x-d'')^2+\frac{p\,d''\,b''}{b'}\times(x-d''+x)=q\,(d-d'-x)^2+$$

$$\frac{q\,d'\,b\,(2\,d-2\,x-d')}{b'},\ \text{or}\ \ p\,b'\,(x-d'')^2+p\,d''\,b''\,(2\,x-d'')=$$

$$q\,b'\,(d-d'-x)^2+q\,d'\,b\,(2\,d-2\,x-d').$$

Expanding the squares we have

$$p\,b'\,(x^2-2\,d''\,x+d''^2)+p\,b''\,d''\,(2\,x-d'')=q\,b'\,(d^2+d'^2+x^2+$$
$$2\,d'\,x-2\,d\,d'-2\,d\,x)+q\,d'\,b\,(2\,d-2\,x-d'),\qquad\text{or}$$
$$p\,b'\,x^2-2\,p\,b'\,d''\,x+p\,b'\,d''^2+2\,p\,b''\,d''\,x-p\,b''\,d''^2=$$
$$q\,b'\,(d^2+d'^2-2\,d\,d')+q\,b'\,x^2+2\,q\,b'\,d'\,x-2\,q\,b'\,d\,x+$$
$$q\,d'\,b\,(2\,d-d')-2\,q\,d'\,b\,x.$$

And by transposition,

$$(p\,b'-q\,b')\,x^2+(2\,p\,b''\,d''-2\,p\,b'\,d''+2\,q\,b'\,d-2\,q\,b'\,d'+$$
$$2\,q\,d'\,b)\,x=p\,b''\,d''^2-p\,b'\,d''^2+q\,b'\,(d^2+d'^2-2\,d\,d')+$$
$$q\,d'\,b\,(2\,d-d'),$$

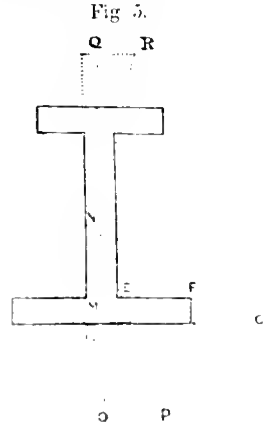
$$\text{hence}\ x^2+\frac{2\,(p\,d''\,(b''-b')+q\,b'\,(d-d')+q\,d'\,b)}{p\,b'-q\,b'}\,x=$$
$$\frac{p\,d''^2\,(b''-b')+q\,[b'\,(d-d')^2+d'\,b\,(2\,d-d')]}{p\,b'-q\,b'}$$

And completing the square, extracting the root, &c., we have

$$x=\sqrt{\left\{\frac{p\,d''^2\,(b''-b')+q\,[b'\,(d-d')^2+d'\,b\,(2\,d-d')]}{p\,b'-q\,b'}+\left(\frac{p\,d''\,(b''-b')+q\,b'\,(d-d')+q\,d'\,b}{p\,b'-q\,b'}\right)^2\right\}}-$$
$$\frac{p\,d''\,(b''-b')+q\,b'\,(d-d')+q\,d'\,b}{p\,b'-q\,b'}\qquad(2.)$$

And thus we obtain the situation of the neutral axis. It must be admitted that the equation is rather forbidding in appearance, but the reduction of the value of x, will not be found so tedious as may at first be imagined, since the quantities are simple, and the same combinations often repeated.

Fig. 5.



5. Assuming that N L, the distance from the centre of the neutral axis, to the bottom of the girder, has been found by equation 2; we shall at once be able to determine the dimensions of a rectangular beam, whose strength shall be equal to that of the girder.

The figure being constructed as before, produce N L to O, and N E to P, and let O P be drawn at right angles to N O, the distance L O being supposed to be such, that the area of the figure M E P O, may be equal to that of the figure M L G F, and consequently, that the triangle N O P, and the figure N L G F E, may have equal areas. Since therefore the area N L G F E, which represents the resistance to fracture of that portion of the girder below the neutral axis, is equal to the triangle N O P, which will indicate the resistance of the middle rib, produced to an imaginary point O: by finding the distance L O, we shall obtain the dimensions of a simple rectangular rib, having a strength equivalent to that of the portion of the girder below the neutral axis N.

Let the known distance N L, be represented by (a), and L O by (x), and the other dimensions remain as before.

Then $a-d''\,:\,\frac{b''}{2}\,::\,a\,:\,$ L G or L G $=\frac{a\,b''}{2\,(a-d'')}$,

and $\dfrac{d''\left(\frac{b''}{2}+\frac{a\,b''}{2\,(a-d'')}\right)}{2}=$ area of figure M L G F.

Again, $a-d''\,:\,\frac{b'}{2}\,::\,a+x\,:\,$ O P or O P $=\frac{b'\,(a+x)}{2\,(a-d'')}$.

And $(x+d'')\times\left(\dfrac{\frac{b'}{2}+\frac{b'\,(a+x)}{2\,(a-d'')}}{2}\right)=$ area of figure M E P O,

hence, by the construction we have the equation,

$$d''\left(\frac{b''}{4}+\frac{a\,b''}{4\,(a-d'')}\right)=(x+d'')\times\left(\frac{b'}{4}+\frac{b'\,(a+x)}{4\,(a-d'')}\right)$$

$$\text{or}\ \frac{d''\,b''}{4}\left(1+\frac{a}{a-d''}\right)=\frac{b'\,(x+d'')}{4}\left(1+\frac{a+x}{a-d''}\right)$$

Multiplying by $4\,(a-d'')$ we have,

$$d''\,b''\,(a-d''+a)=b'\,(x+d'')\times(a-d''+a+x)$$
$$\text{or,}\quad d''\,b''\,(2\,a-d'')=b'\,(x+d'')\times(2\,a+x-d''),$$
$$\text{and,}\quad d''\,b''\,(2\,a-d'')=b'\,(x^2+2\,a\,x+2\,a\,d''-d''^2)$$
$$\text{hence,}\quad\frac{d''\,b''\,(2\,a-d'')}{b'}=x^2+2\,a\,x+2\,a\,d''-d''^2$$

$$\text{by transposition,}\ \frac{d''\,b''\,(2\,a-d'')}{b'}+d''^2-2\,a\,d''=x^2+2\,a\,x,$$

$$\text{completing the square,}\ \frac{d''\,b''\,(2\,a-d'')}{b'}+d''^2-2\,a\,d''+a^2=x^2+2\,a\,x+a^2$$

$$\text{extracting the root,}\ x+a=\sqrt{\frac{d''\,b''\,(2\,a-d'')}{b'}+(d''-a)^2},$$

$$\text{or,}\quad N\,O=\sqrt{\frac{d''\,b''\,(2\,a-d'')}{b'}+(d''-a)^2}\qquad(3.)$$

The points Q and R, having been assumed in the same manner as O and P, we shall have the proportion, O P : Q R :: p : q, and as the triangles N Q R, N O P, are equal,

O N : N Q inversely as p to q,

that is, N Q $=\frac{p\times O\,N}{q}$,

and the whole depth, O Q $=$ N O $+\frac{p\times N\,O}{q}$ (4.)

It will be seen therefore, that by applying the equation No. 2, to ascertain the position of the neutral axis, and subsequently Nos. 3 and 4, we obtain the depth of an imaginary rectangular beam, having the same thickness as the middle rib, whose strength shall be equal to that of the girder, thus bringing us within the reach of the usual formula.

It may be as well to repeat the remark made at the commencement, that this system is not proposed for practical application in common cases; the essay being merely intended, as an exposition of another mode of viewing the action of the transverse strain, and as affording a means, should the principles be found correct, of testing the accuracy of the common approximate methods.

Derby, August 11, 1841.

Pacific Steam Navigation.—Extract of a letter received by the Directors of the Company from Mr. Wheelwright, dated Lima, April 28, 1841.—"Captain Peacock arrived here on Saturday, the 24th, having consumed nothing but Chili coal during the voyage:—his calculations have been most beautifully carried out, for he has not been 15 moments out of his time, on arriving at and sailing from each port in the voyage, from Talcahuano to this place, a distance of nearly 1,700 miles: and it affords me pleasure to remark, that his zeal in the cause of the Company merits the highest praise. His ship is, am happy to state, well regulated with a due regard to economy, and the several departments are most judiciously arranged."

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXX.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. It is a most fortunate circumstance that the Croakers, and Screech-owl school of philosophers, both contradict each other, and are contradicted by experience; else we should have a most woful time of it, were we to pay attention to all their notable advice in regard to the *hygeine* regimen of architecture. At one time the public —at least the *nervous* public—are scared by being told that St. James' Park is the seat of malaria, and by being made to believe that Queen Victoria actually dwells in the midst of pestilence, although she does so only metaphorically, like all sovereigns, amid the moral malaria of a court. Next come the ventilation folks, who would fain persuade us that we are now all suffocating ourselves in rooms whose atmosphere is incapable of supporting animal life, owing to our present defective modes of construction. And indeed were the atmosphere in our houses as oppressive and suffocating as their doctrines, it would be so deadly, that I question if any sort of ventilation could correct it—except it were the ventilation occasioned by a hearty laugh. It was certainly a very great piece of presumption on the part of the Old-Londoners to presume to exist, as they did, cooped up in narrow lanes and alleys, where the different stories of the houses, projected over each other, so that the occupiers of the garrets could *Pyramus-and-Thisbe* with their opposite neighbours. No less impertinent is it that even nowadays, people will presume to fancy they can contrive to exist huddled together in the cabin of a steamer, in an atmosphere reeking with frowsiness!—and sleeping in boxes, not very much bigger than—and certainly not so well aired as, an ordinary dog-kennel. Did I wish to set up a fussy doctrine of my own, I should say that sea-sickness is chiefly occasioned by the horrible agglomeration of impurity condensed between the decks of a ship. Nevertheless instead of keeping quietly at home in their own comfortable rooms, many people are seized every season with a desperate fit of fidgetiness, until they can regale themselves with fresh air in a steamer, and squeeze themselves into poking little rooms in crowded lodging-houses, peopled from Cockney-Land, in a place that looks just like a suburb of it.—Well if the Ventilation folks can frighten them a bit, they may so far do good. If too, their doctrine be worth anything, an act ought to be passed making it a cognizable offence, for any one to get a genteel *squeeze*, especially if their "saloons," as the newspapers call them, consist of no more than two ordinary-sized upstair parlours, with a little cabin beyond them, made to perform the part of Boudoir—for that 'night only'. As for that, it matters very little how many or how spacious the rooms themselves may be, if more persons are to be crammed and jammed into them than their area can well contain; for it is no less absurd to attempt to pour a gallon into a quart mug, than a quart into a pint one. "Was not the squeeze, last night at ——'s actually insupportable?" was a question once asked, and produced the following reply: "It was, indeed, tremendous, but not insupportable, since the gentlemen supported the ladies, and the ladies supported the gentlemen."

II. Though the first has been a long one, I must give a second act to the farce of Ventilation. If the Terrifiers be in the right, ought not all under-ground kitchens, servants' halls and other rooms, to be strictly prohibited?—or does it not matter whether the High-Life-below-stairs part of the creation are suffocated or not? We are told that those whose avocations compel them to be chiefly in the open air, are proportionable healthier than others; and in proof of this we are perhaps referred to the striking difference between a ploughman, and a weaver;—a gamekeeper ranging about the woods, and a tailor doomed to sit all day upon the piece of wood called his shop-board. In all such arguments the stress is laid exclusively upon the single circumstance that happens to make for it. Here, the difference is attributed entirely to air,—to exercise, diet, &c., nothing. Should a tailor chance to drink himself into his grave, the "Ventilators" would seize upon him —not exactly after the fashion of body-snatchers,—but as an instance of the deplorable consequences of the want of fresh air. Well but put exercise to fresh air, and good appetite and its wherewithal, to them both, and they achieve wonders.—Yet, your jolly, jovial, foxhunter dies at the venerable age of forty, while some poor feeble, sickly, bookworm who immures himself almost constantly within his study, outlives another foxhunting generation, keeping among the living for fourscore years.—It is unnecessary to repeat so well known an anecdote as that of Fontenelle's "slow poison;"—which, by the by, is only one of the slow poisons which certain ingenious gentlemen have from time to time invented for the laudable purpose of alarming their neighbours. I remember once reading an awful medical invective against carpets,—the general use of which was said to have rendered people less healthy and long-lived than their ancestors who were unacquainted with such foolish luxuries. Yet I make no question but that the Doctor himself had his rooms carpetted, as well as his neighbours.

III. The author of the World of London, in Blackwood's Magazine, speaking of the building at the corner of Downing-street, observes that it is by "Sir John Soane, of Bæotian celebrity, who, together with Nash, has done so much to deprave our metropolitan taste in architecture, that another invasion of the Goths and Vandals were more to be desired than deplored." Indeed it is truly wonderful, and not a little scandalous also that two such Bæotians as Soane and Nash should have obtained fat-headed patronage to the extent they did, and been permitted to play their tasteless and extravagant pranks, while John Bull paid the piper. Both of them were addicted to the expensive practice of experimentalizing with their buildings, constructing, pulling down again, and reconstructing afresh, as if alterations of that kind cost no more time or money than they would have done in a drawing. Such was notoriously the case with Buckingham Palace, such too was it with the Downing Street edifice, which after all is unfinished, and doomed never to be finished, it having been commenced so Bæotianly and bunglingly that it cannot possibly be continued Northwards without either being twisted, or else projected into the street, so as to extend across the foot-pavement. Therefore it is likely to remain as long as it lasts, in statu quo,—a monument of its architect's taste, and his great affection for the "scored pork" style, and likewise of his extraordinary ingenuity, the entablature being most artfully contrived to block up a series of mezzannie windows just behind, and separated from it merely by an interval of three or four inches. It is lucky for Soane that this fault has escaped the notice of his friend Gammon, who has just found out what he might have discovered many years ago that Soanean Gothic is very *so-soish* stuff. But poor little Gammon's esteem for Soane, has steamed itself quite away, and is now utterly evaporated.

IV. One of the least exceptionable samples of Soane's taste is the basement of the State Paper Office, St. James' Park, where he has introduced a rather novel mode of rustication, which is at once rich and sober in effect. There are also one or two other good points about that building, although as a whole it is not particularly happy. It appears to be no more than a private house, and even as such by no means a large one. Most certainly there is nothing whatever in the exterior to indicate, or even remotely suggest for what particular purpose the building was erected. In regard to Soane's works generally, it is somewhat remarkable that they have been so very little noticed by foreigners, either for approbation or the contrary. The venerable architect's affection or appetite for his "scored pork" was so inordinate, that he did not scruple at times to employ that singular species of decoration even internally.

HINTS ON ARCHITECTURAL CRITICISM.—Part I.

It is a very delicate thing to insist on primary principles, when the very suggestion that a knowledge of those principles is necessary, seems almost like a whisper of insult. Thus, to intrude with an alphabet for the critic, in an age when men have grown grey in criticism, becomes scarcely pardonable;—nay it would be almost dangerous, but for the suggestive attitude the writer would assume, in pleading anew those elemental truths, by which alone the critic can arrive at an equitable conclusion. If therefore, out of regard perhaps for one or two, (who have viewed the vision of Palladio's family with horror, as if the harmless race of a Banquo had been passing in review,) I draw for a little a veil upon the past to introduce a new subject, and appear on a new scene, the spectator must judge me mildly; for I am no literary coxcomb, pulling myself into notice, but anxious,—deeply anxious, to remove some of those weeds, which entangle around to choke the beautiful flowers of a still more beautiful art.

The subject of consideration, is criticism, which, like politics, betrays many currents of opinion, and many hostile enthusiasts.

It is right that there be enthusiasm, for without it art would slumber, but it is also right that every persuasive argument be adduced, to free the mind from certain prejudices, which lead the enthusiast astray; and it is a commendable task, to try at turning these various currents of opinion into one deep channel, the original source of which shall be "truth."—This preface must suffice. I am satisfied after this attempt at beckoning the attention towards what I would present, to leave it to the reader to judge, whether I quibble merely for indefinite purposes, or strive with the noble and the proud aim of ameliorating my country's art.

First, what is criticism?—Criticism is a branch of polite science, and when found in union with art becomes an index to its position. From this arises its importance. It is also a court, where the several disputes of art are brought to issue, and upon the decisions of which the public opinion stands: hence arises its influence. The foundation of its laws, is based on sense, imagination, and judgment, as the three natural powers it attempts to move. Its laws of adjudication vary according to the claims of art, and according to the nature of appeal; and from the labour necessary to frame these laws, and to apply them, is inferred the necessity of their adoption. An appeal to the judgment of criticism, is based upon plausibility, and implies public assent to certain principles; these however, critics as counsel in the social contentions of art, quarrel upon, whilst the judge "nature" sits to disentangle and apply them. The arguments vary first, according to the art, and secondly, accordingly to the nature of its claim,—its claims being always in the shape of some emotion, (emotion being the aim of the affecting arts) the fitness, or unfitness of which, for the present is immaterial. The institution of the court itself, is founded upon presumed error, as implying an uncertain acquaintance with those laws, which are the philosophy of our taste. It follows then, in order to meet the wisdom of such an institution, that the principles which detect the propriety, or expose the error of appeal, should be free from arbitrary application. It is first then, upon the necessity of a judgment in matters of art, secondly,—upon the required clearness of the laws of judgment, and, thirdly, upon the arbitrary interpretation of those laws, which interpretation, I for the present assume to exist, that I am induced to throw out a few hints on criticism, which I hope will be received by the reader with a politeness due to the subject, however in exhibiting this politeness, he may disguise a dislike to what may appear officious interference in the writer. However these hints may be generally received, the man of correct taste knows that it is not an irrational task, to dissect those principles which aid us, or ought to aid us, as we either feel or affect a love for the great examples of art. He knows that about architectural excellence there is an air of mystery: so that without any implied reproach upon the elegance of any choice hitherto made, or which may be made, he would prefer our being guided by principle, rather than by instinct, in our search after the beautiful, and that instead of wrangling over fragments, like beasts over carcases, he would choose an explanation of the real basis of choice, of which a noble profession cannot be ashamed. The very circumstance of our choice being a habit, requires that some effort be made to enlarge and unfetter the mind, so that by infusing into it those ideas which are the very key to effective design, we may stand in rivalry with the ancients;—adopting if we please their beauties, but adopting them from choice, not from necessity.

I feel strongly on the subject, because it is so important that architecture should rank amidst the poetic arts, and that the attainment to architectural excellence, shall be only by the acknowledged effort of genius. I feel strongly too, because I conceive it is owing to our negative character as artists, and our supine imitation, that critics rise no higher in their views. The architect of original bent, feels the incompetency of ordinary men to discuss his claims: a critic in his idea, being a man who has only read through Creasy or Stewart, or if learned in Christian architecture, has his dictionary of reference only in some convenient examples. He is unfamiliar with the man of that severe yet elegant mind whose opinion he covets. He has been deceived in fancying architecture an art, where conception, the inseparable companion of genius, might alight. The root of the defect at once appears in criticism, which is confined to certain laws inimical to invention. The evil of this criticism is, that it limits that range of mind which every other poetic art allows, and is either founded on a presumption against the poetry of the art, or against the ability of its students. If in the former ground it is inconsistent, because that combination of parts, with the ancients so fortuitous, being deemed by many the monopolist of beauty, shows an argument then against the poetry of the art, for poetry is confined to no set disposition of forms. If on the latter ground it is a libel upon the genius of our nation, and stagnates by its mean policy, those efforts which might introduce fresh beauties amongst us. I admit that our rules are protective, and exclude many incongruities; but would it not be more honourable to make the antique amenable only to fresh creations? very possible if as artists we catch the spirit of our masters. It being evident then, that our art for inventive beauty is far behind the other arts, with which it claims sisterhood, and that however good this claim to equality may be, it does not appear either from the pen of the critic, or the example of the architect, to be so dignified; it follows, as a natural consequence, that to maintain this kindred claim, there should be shown a similarity of laws, by which the composition is governed, and by which the emotions are engaged: it follows too, if this be the case, that then, our laws of criticism are erroneous, or capricious, being essentially at variance with those of other arts.

In watching the progress of a design, in either art, to its completion, that is in observing that anatomy of thought out of which the composition is formed, we may perceive a relationship existing, although we do not yet admit its existence. We read an able critique upon poetry, music, sculpture or painting, and the mind responding with ready fidelity to truth, becomes at once conscious that it hears in that criticism, but the echo of its own suggestions: but architectural criticism we do not feel in this way, and purely because its compositions are not criticized on the same ground, the mechanical being ever judged as in partial skirmish with the poetical. Architecture however, is not more mechanical than the other arts, for the conception which occupies the brain of the poet, or the painter, can only acquire a correct and tangible shape by a process of adjustment. Calculation enters into the design; associations are dwelt upon: and the sentiment which is to appear is only featured by a careful arrangement. Music, amidst all its sweetness and harmony, has its mechanism. The rush of chords, the softer modulation, independent of the art, which, if I may so speak, can embody for the ear its anticipations, is but the sale of a passion, or a sentiment, shaped and tutored in the mind, with reference to situation, circumstance, time and probability. Each art is alike too in its finished performances: they are so many appeals to the mind through the senses; music, through the ear, sculpture, painting, and architecture through the eye, poetry through the eye and ear, and it is upon this beautiful and exquisite web of sensation, that the power of art moves. But supposing that architecture be equally with the other arts, a mirror where the eye can seek objects, which the mind may enjoy, a barrier intrudes itself at once, in the shape of that word, "taste," (which like the ghost of Junius assumes a variety of shapes) to make it doubtful after all, whether there can be shown common grounds, upon which the feelings are moved. It will be necessary then, to define this word "taste," because if this be unexplained, we may be only right by chance.

It has been deemed a fruitless task, to reconcile to a principle the varying opinions current upon the same object in arts, each of which is termed the opinion of taste, because of the different degrees of sensibility and imagination found in different minds, and because it has been observed, that the same object, which is viewed carelessly by one man, fills another man with exquisite delight. Strange as these differences may appear, they are all to be traced to one source. The taste of a man which is a progressing principle, receives its perfect development only from time. Taste which in infancy is mere sense, becomes improved as imagination and reason blend to assist it.—Taste resulting not from a simple idea, but from the union of reason and imagination, varies then not according to that chance inseparable from a simple notion, but according to the effort of the imagination and the exercise of the judgment, the latter quality of the mind being a determinable thing, whose degree of ability is proportioned to the attention and care bestowed. Imagination too, though a power extremely elastic, resembles when engaged with architecture, either more or less that faculty we denominate "taste," for its essential power then lies in tracing resemblances, and it is either perfect or advancing towards perfection, according to the degree of judgment in simultaneous exercise. Thus taste is subject to degree, and according to this degree of taste in different individuals, we find the degree of refined pleasure which a work of art produces. Taste which is a habit is therefore imperfect taste, because inimical to progression. Hence habit which is the origin of our views in a great measure, may explain the source of our architectural taste.

Independently of this definition of taste, and the grounds of its support, there is a further difficulty attendant upon its application to architecture, from the circumstance of there being little or no direct appeal to the sympathies, which the painter, the poet, and the sculptor, so powerfully affect, and which the rudest mind intuitively feels, without previous study, to acquaint him with the source of his emotion. This is one reason why public opinion varies so much; men untaught, with their judgments unassisted, feeling that emotion is the object of the art, are precipitated into hasty conclusions, just because their sympathies cannot be awakened. A correct taste in architecture is more difficult than in any other art, because the ideal resemblances affecting the mind are more remote: and this is the reason why the taste is pleased by figures, pictures, statues or striking ornaments, to the prejudice very often of a taste strictly architectural:—the mind being conducted towards familiar objects.

The essential difference between architecture and the other poetic arts, consists then in this suggestive character, whilst the poetry it exhibits, appears in expression, attitude, or relative position. It has however, all the attributes of the other arts at command, and which it makes subsidiary; and thus its claims to criticism are as strong and as important, as the noble art of the painter, or the sculptor. Having then endeavoured to state that architecture is equal to the other arts, in its claims to liberal criticism, I shall reserve it for my next to show the origin of its effects upon the mind, by a definition of that faculty, inherent in us, by which we extract emotion from attitude, proportion and position, even when these three essentials have no counterpart in nature.

FREDERICK EAST.

August, 1841.

ENGINEERING WORKS OF THE ANCIENTS, No. 8.

DIONYSIUS of Halicarnassus who lived in the time of Augustus, is the next author who contributes to our series, having extracted from his Roman Antiquities the following accounts of Roman works.

BRIDGE OVER THE TIBER.

Ancus Marcius, the 4th King of Rome (B. 3, ch. 14,) is said to have been the first who built over the Tiber the famous wooden bridge, which is considered as sacred. It must only be made of wood, and neither iron nor copper may be used in it. When any damage occurs it is the duty of the pontiffs to see to the repair, and to perform certain sacrifices prescribed by law during the progress of the works.

Ancus Marcius greatly enlarged the city of Rome, and built the port of Ostia at the mouth of the Tiber.

SEWERS.

TARQUINIUS PRISCUS, the 5th King (B. 3, ch. 20), built the walls of Rome of large squared stones, and commenced the sewers, by which the waters are collected in the streets of the city, and carried into the Tiber. The work is admirable, and beyond anything that can be said. For my own part, I believe that Rome has nothing more magnificent, nothing which better shows the grandeur of her empire, than her aqueducts, streets, paved roads, and sewers: I judge thus not only on account of their utility, but still more on account of the immense outlay which they have required. To prove what I assert, I will only instance the sewers. According to Caius Aquilius, having been for some time so neglected that they were stopped up, the censors concluded a bargain with a contractor to clean and repair them for a thousand talents.

We cannot pass over this tribute of the old historian without remarking that while the temples of Greece are scattered in ruins, and their proudest ornaments become the trophies of barbarians, the roads, aqueducts, and sewers of the Romans still minister to the wants of nations, centuries after the power of their founders has ceased to exist. The English emulate the Romans in the useful nature of their enterprises, and we trust that the labours of our engineers may minister as long to the service of the world as those of their predecessors.

GREAT CIRCUS.

Tarquin also embellished the Great Circus between the Aventine and Palatine mounts, and was the first who constructed around this circus covered seats, whereas the practice formerly was to place scaffolding around.

TARQUINIUS SUPERBUS.

Tarquin the Proud (B. 4, ch. 10,) the seventh and last king of Rome, employed the people on the public works in order to occupy them and prevent them from plotting. He continued to the Tiber the sewers begun by his grandfather, and carried out several of his unfinished works.

STRABO.

Having thus dismissed Dionysius of Halicarnassus, we come to Strabo, one of the most celebrated of the geographical writers of the ancients, and from whom, as from Diodorus Siculus, much information is to be gleaned as to ancient mining, a most important branch of engineering, as bearing upon earthworks. We shall first take the third book.

MINES IN SPAIN.

A chain of mountains, (the Sierra Morena), parallel to the Betis (Guadalquivir) extends towards the north, approaching more or less the banks of the river; it contains a great many mines. Silver is found every where in the neighbourhood of Ilipo and Old and New Sisapone (Almaden). Near the place called Cotinas, gold and copper are worked together. The mountains on the banks of the Anas (Gaudiana) also contain mines.*

* B. 3. ch. 2.

From Turdetania is exported cinnabar equal to that of Sinope. There is also found fossil salt.

What renders Turdetania particularly remarkable is its excellent mines. In fact all Iberia is full of them; but Turdetania unites all the advantages of a mining country to a degree which surpasses any praise. In no country in the world do we find gold, silver, copper and iron in such quantity or of similar quality. Gold is obtained not only from the mines but also from the rivers and streams, in which it is contained mixed with sand. It is also to be found in many dry places, but with this difference, that in these it cannot be distinguished at sight, whilst it shines when covered with the water. This is the reason why water is made to pass over sandy places, to make the particles of gold shine. Wells also are dug, and many means have been invented for separating the gold from the sand by washing, so that there are more gold washing works in the country than mines. The Gauls assert that their mines, as well those of the Cevennes as those of the Pyrenees situated on their side, are better: but, nevertheless, the mines on the Spanish side are generally more esteemed. Among the particles of gold are sometimes lumps of gold weighing half a pound, which are named *pales*, and require very little refining. In cutting stones of ore, small lumps of this metal are sometimes found. After having roasted the gold intended to be purified, by means of an aluminous earth mixed with it, the result of the operation is the alloy of gold and silver known under the name of *electrum*. It is again placed in the fire, which separates the silver, and leaves the gold pure: for this latter metal is easily fused, and is not of much hardness. It is also fused sooner by the flame of straw, which, being milder, agrees better with the nature of gold, which obeys its action, and dissolves easily, while charcoal, being stronger, consumes a great part by liquefying it too soon, and converting it into vapour. As to the beds of rivers, the particles are extracted, washed in buckets, or in wells or holes made near, and the earth is washed. The furnaces for melting silver are generally made higher, to enable the pernicious vapour of this metal to rise and be dispersed. Some mines of copper have the name of gold mines, whence it is presumed that they formerly supplied this metal.

Posidonius, in speaking of the number and excellence of these mines, uses all the exaggerations of an enthusiast. The Turdetanians, says he, use the greatest industry and labour in digging winding galleries far into the earth, and often in draining, by means of Egyptian spirals, the subterranean streams with which they meet. But their lot, he observes, is very different from that of the miners of Attica, to whom may be applied the ancient enigma, "They have not taken all that they have drawn from the earth, and they have left there what they possessed." The Turdetanians, on the contrary, draw from their mines enormous profits, since the fourth of the earth which they extract from the copper mines is pure copper; and the silver mines furnish private individuals in three days with a quantity of this metal equivalent to a Euboic talent. As to tin, according to the account of Posidonius, it is not found on the surface of the earth, as some historians assert, but it is also extracted from mines. Mines of this metal are found among the barbarous people who inhabit beyond the Lusitanians and in the Cassiterrides Islands, and tin is also brought from the British islands to Marseilles. Among the Artabri, in Gallacia, the last people of Lusitania, on the north and west, there is earth covered with a dust of silver, tin, and of the metal, known under the name of white gold, on account of its alloy with silver. This dust is brought down by the rivers, raked up by the women, and then washed by them in sieves placed upon baskets. This is what Posidonius says as to the mines of Iberia.

Polybius, in speaking of those of silver which exist near New Carthage (Carthagena) says that they are 20 stades from the city, that they are so great that they extend over a district of 400 stades in circumference, that they habitually employ 40,000 workmen, whose labour brings to the Roman people 25,000 drachms per day (about £350,000 per annum). I do not enter into the detail of all the other operations, which would be too long, I confine myself to what Polybius says as to the manner in which the silver is treated, which is contained in the rivers and torrents. After having pounded and sifted it over water, what remains is separated from the water and pounded again: after having been sifted again, it is pounded and sifted five times in all. After this the pulverized matter is melted to separate the lead contained in it, and the silver remains pure. These mines of silver still exist, but there and elsewhere they belong to the state no longer, but have been taken possession of by private individuals; those of gold on the contrary mostly belong to the state. Here as well as at Castalon (Caslona) and in other places are mines of lead, which contain silver, but in too small quantity to defray the expense of separation.

* B. 3. ch. 2.

A little way from Castalon is the mountain whence the Betis (Guadalquivir) springs; it is named the Silver Mountain, on account of the mines of that metal which it contains.*

Lusitania is watered by great and small rivers which contain many grains of gold. Although the country abounds in gold, the inhabitants preferred living by plunder.†

The mountains in the neighbourhood of Malacea (Malaga) contain in several places mines of gold and other metals.

Not far from Dianium (Denia) are very fine forges.‡

WORKS IN SPAIN.

In the neighbourhood of Asta (Mesa de Asta), Nebrissa (Lebrisa), Onoba (Gibraleon), are canals dug in several places to facilitate the navigation.§

Near Cadiz is to be seen the Tower of Cæpio built on a rock, washed on every side by the sea. This admirable work was constructed in imitation of the Pharos of Alexandria.‖

SCILLY ISLANDS.

The inhabitants trade in the tin and lead which they dig from their mines. Publius Crassus, who went there, found that their mines are not very deep.

WORKS IN GAUL.

The extracts which follow are from various books.

Marius, perceiving that the mouth of the Rhone was becoming gradually shoaled up, had a new channel dug, which received the greater part of the waters. This canal he gave to the Marseillese in recompense for their service in the wars, and it became to them a great source of riches on account of the dues which they levied on those who went up or down.¶

The road from Iberia to Italy passes through Nimes. It is good enough in summer, but very bad in winter and spring, on account of the rivers overflowing and depositing mud. This road passes several rivers by boats, or by bridges of stone or wood.**

The territory of the Cevennes abounds with gold mines.††

The Tarbelli, a people of Aquitaine, are in possession of the most esteemed gold mines: for without digging deep, lumps of gold as big as the hand are sometimes found, requiring only a slight washing. The rest of the mine consists of grains and lumps, which do not either require much work.‡‡

BRITAIN.

Britain produces gold, silver, and iron.§§

LIPARI.

Lipari has very productive mines of alum.‖‖

ROMAN ROADS AND BRIDGES.

The Romans, says Strabo, have principally employed themselves upon what the Greeks have neglected—I mean paved roads, aqueducts, and those sewers which drain the city of Rome. In fact, by cutting through mountains and filling up vallies, they have every where throughout the country made paved roads, which serve to convey from one place to another the goods brought by sea to the ports. The sewers of Rome, arched with dressed stone, are broad enough in some places for a cart laden with hay to pass; and the aqueducts bring water in such abundance as to form streams running across the city, cleansing the sewers, and are sufficient, as it may be said, to supply all the houses with great fountains, canals and reservoirs. This last advantage is principally owing to the cares of Marcus Agrippa, who has decorated Rome with many other public monuments.¶¶

The principal of the great roads which traverse the country are the Appian Way, the Latin way, and the Valerian Way.***

According to modern accounts, the Valerian way was about 100 miles long; for the first 15 miles are found ruins of bridges, causeways, &c. Beyond, the remains of it are not so evident, but the boldness with which it is carried across three mountain chains is surprising.

Near the city of Como, to master the people disposed to robbery, roads have been constructed, which are as practicable as it is possible for art to make them. Augustus, not content with clearing the roads of the banditti, has made them as convenient as possible, although the country is very difficult.†††

M. Emilius Scaurus constructed the Emilian Way running to Sabbata and Darthon: and there is another Emilian Way, which continues the Flaminian Way, and was the work of M. Emilius Lepidus, colleague of C. Flaminius* (This is an error of Strabo in attributing the Flaminian way to this Flaminius.)

The Salarian Way is a great road very short.† To it joins the Nomentan Way.

The Appian Way is paved from Rome to Brendisium (Brindisi), and is the most frequented of all the roads made in Italy. Beyond Terracina on the Roman side, the Appian way is bordered by a canal, which receives the water of the marshes and rivers. It is particularly by night that this way of the canal is preferred; upon it people embark in the evening, and leave it in the morning, and take for the rest of the journey, the Appian Way, but even in the day-time the boats are towed by mules.‡

Near Baiæ is an isthmus of a few stades, through which a road is tunnelled. Near Naples is a similar one, which, in the space of several stades, crosses the mountain situated between Neapolis and Dicearchia. Its breadth is such that carriages which meet find no difficulty, and light is admitted by several openings pierced internally from the surface of the mountain through a great thickness.§

The Aternus (Pescara) in the country of the Peligni is passed by a bridge 24 stades from Cortinium.‖

CANALS.

The greater part of Transpadane Italy is full of lagunes, and therefore the inhabitants have made canals and dykes as in Lower Egypt, a part of the inundated ground being drained and the rest navigable.

Epiterpum, Concordia, Atria, Vicetia, and some other small places in the neighbourhood of Ravenna, by small navigable canals communicate with the sea.

The Cispadane was for a long time covered by marshes, which arose from the superabundance of the waters of the Po, but Scaurus, by having navigable canals dug from Placentia to Parma, drained the plain.

Ravenna is a great city built on piles in the midst of the marshes, and intersected with canals, which are crossed by boats or bridges.¶

DYKE.

The Locrine Gulf in its breadth extends as far as Baiæ, and is separated from the external sea, in a length of 8 stades by a dyke broad enough for a great waggon to pass. This dyke it is said is the work of Hercules; as in rough weather the waves flowed over it, so as to make it impassable for foot-passengers, Agrippa had it raised higher.**

TIMBER.

From Tyrrhenia (Tuscany) is obtained timber for building, of which is made very long and straight beams.

Pisa supplies timber for building much used by the Romans.††

CEMENT.

Dicearchia or Puteoli has become a place of great trade, on account of the works by which it is sheltered, having in the sand of the neighbourhood (puzzolana) great facilities for such constructions. This sand employed in a certain proportion with lime, makes a body, and becomes very solid.‡‡

MINES AND QUARRIES.

The Salassi have gold mines, the working of which was facilitated by the Durias (Doria) which supplied the water required for the washings; so that, by diverting the courses by numerous branches, they often dried up the main bed, which was the cause of constant war with the neighbouring people, whose agriculture was affected. The Salassi, although conquered by the Romans and dispossessed of their mines, being masters of the mountains, continued to sell water to the mine contractors.

Polybius relates that in his time among the Taurisci Norici, (people of Corinthia, Istria, &c.) were mines of gold so rich that by digging the ground only two feet deep gold was met with, and that the ordinary works were not more than fifteen feet deep; that a part was native gold, in grains the size of a bean or a lupine, which in the fire only diminished an eighth, and that the remainder, although requiring to be more purified still, gave a considerable product. [He adds] that the Italians having entered into agreements with the barbarians for working these mines, in the space of two months the price of gold fell throughout Italy a third, and that the Taurisci having perceived it, turned out their foreign colleagues, and sold the metal themselves. At the present day the Romans possess these mines. The rivers, also, like those of Iberia, contain grains of gold, although in smaller quantity.§§

Near Acyleia (Aquileia) are mines of gold and iron easy to work.‖‖

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* B. 3, ch. 2. † B. 3, ch. 3. ‡ B. 3, ch. 4. § B. 3, ch. 2. ‖ B. 3, ch. 1. ¶ B. 4, ch. 1. ** Ib. †† Ib. ‡‡ B. 4, ch. 2. §§ B. 4, ch. 5. ‖‖ B. 6, ch. 4. ¶¶ B. 5, ch. 7. *** B. 5, ch. 7. ††† B. 4, ch. 6.

* B. 5, ch. 2 † B. 5, ch. 6. ‡ B. 5, ch. 7. § B. 5, ch. 10. ‖ B. 5, ch. 9. ¶ B. 5, ch. 2. ** B. 5, ch. 7. †† B. 5, ch. 4. ‡‡ B. 4, ch. 2. §§ B. 5, ch. 6. ‖‖ B. 5, ch. 2.

Cisalpine Gaul has mines which are not worked so much as they used to be, perhaps because they produce less than those of the Transalpine Celts and of Iberia, but formerly they were worked very much, since a mine of gold was wrought even in the territory of Vercelli.*

In the territory of Poplonium (Capo di Campana) are some abandoned mines, and the forges in which is wrought the iron of Elba, which, as it can only be reduced in the furnaces, is transported to the continent, as soon as it is brought out of the mine. Strabo says that the excavation of these mines grew up.†

Pithecusa (Procida) has gold mines.‡

Near Luna in Tyrrhenia are the quarries of marble, white, and spotted with green, of which tables and columns are made of a single block. These quarries are so numerous and so well supplied, that they are sufficient for most of the fine works which are made at Rome and throughout Italy.

The Pisan territory has an abundance of marbles.§

Gabii near Palestrina is in the midst of the quarries most used by the Romans.

At Tibura (Tivoli) are quarries of those different kinds of stones known under the names of Tibnrtines, Gabians, red stones, of which most of the Roman buildings are constructed.||

* B, 5, ch. 2. † B. 5, ch. 4.
‡ B. 5, ch. 2. § B. 5. ch. 4. || B. 5. ch. 7.

ON THE FORMS AND PROPORTIONS OF STEAM VESSELS.

Sir—Among the numerous opinions which have been advanced, as to the causes of the failure in point of speed which has attended the voyages of the British Queen and President, a subject to which the non-arrival of the latter vessel has given a most painful interest, I have not met with one which appears at all conclusive or satisfactory. Deficiency of power is always the first reason assigned; and a writer in a professional periodical, assuming that the models of these vessels are as perfect as any in existence, has gone the length of asserting that the power necessary to produce the same speed in vessels of similar form, but different dimensions, must increase in a larger ratio than the tonnage. His first position as to the forms of the vessels could, I think, be easily proved untenable, and his conclusion tends to subvert a plain physical principle; as he would make it appear that to overcome the resistance of the water, in which the *surface* of the immersed portion of the vessel alone is concerned, requires power increasing in a greater proportion than is requisite to conquer the inertia; the latter being always directly as the *mass*. Yet similar opinions are avowed by most persons who place reliance on the popular notions prevalent respecting the models of these steamers.—The nearest approach to the true manner of considering this question which I have yet seen, is, I think, made by a correspondent signing himself E., in the number of your Journal for last January; where he remarks that of the vessels he mentions, the best have the most beam in proportion to their length; and afterwards, that more seems to depend on model than power. Taking somewhat similar ground, I shall endeavour to show that as regards the several points of speed, capacity for carrying fuel to advantage, efficient working of the paddles, good qualities as seaboats, and power of carrying sail on an emergency; one essential requisite for seagoing steamers is a good breadth of beam in proportion both to their length and depth; and out of these considerations will arise others as respects the most advantageous modifications of form in the fore and after body. On all these points I shall confine myself, as much as possiible, to such remarks as arise from known facts, my intention being merely to state opinions resulting from a good deal of observation, on a subject which I do not think has ever received the attention it deserves, from those more practically interested in it than myself. The first point to which I would call attention is that of speed. In all the comparisons which I have ever seen drawn as to the relative merits of different steam vessels, the principal data have always been the power of their engines, and the sectional area of the immersed parts of their bodies; and the comparison so far as regards the latter particular has always proceeded simply on the superficial area of these sections, no regard being paid to the increased pressure of the water with an increased depth: so that supposing two vessels have their immersed sectional surfaces parallellograms severally 40 feet wide by 15 feet deep, and 30 feet wide by 20 feet deep, these giving the same result as to area, their resistances are in the abstract considered equal, and any advantage which one such vessel may have in point of speed over the other, supposing their power, speed of engines, &c. to be equal, is always referred to some supposed superiority of form in the entrance and run of the faster vessel. Such a mode of calculation is founded, I believe, on the experiments of M. Bossut, who gives as a rule that any plane surface moving with a given speed perpendicularly against a fluid, suffers a resistance equal to the weight of a column of the fluid, with a base equal to the area of the moving surface, and of such a height as a body must fall to acquire the given velocity. I have never seen the details of these experiments, nor do I know whether they are within my reach, but I feel pretty certain that the surfaces made use of must have been immersed in all cases the same depth in the fluid, and the difference of dimension must have been made in breadth only, or such results could never have been arrived at. Suppose the two above named surfaces were those of flood gates; to ascertain the pressure of water on each, 600 square feet, the common result of 40×15, and 30×20, must be multiplied into the pressure at the mean depth of each. The pressure of water at the depth of $7\frac{1}{2}$ feet, the mean of 15, may be taken as 3·75 lb. per square inch; and that at 10 feet, the mean of 20, as 5 lb. These numbers multiplied into 86400 the number of square inches in each surface give the results of 325000 lb. = 145 tons 1 cwt. 88 lb. for the first named, and 432000 lb. = 192 tons 17 cwt. 6 lb. for the second, being about as 7 to 9; and yet if the rule applied to calculate the resistances of vessels be correct, these two surfaces when put in motion at the same speed, immediately have their amounts of resistance equalized, because their areas are equal!—Such a result is manifestly absurd; and as the increased pressure of water in the proportion of its depth is an established fact, I shall proceed on these premises to inquire into the manner in which these vessels would be affected by the alteration of form necessary to reduce their resistance in moving through the water. We will suppose, for simplicity of argument, that their transverse sections are uniform throughout, and that both in plan and elevation they are also parallellograms: that they are each of the length of 200 feet, and their cubic contents consequently the same, viz., 120,000 feet.

Fig. 1.

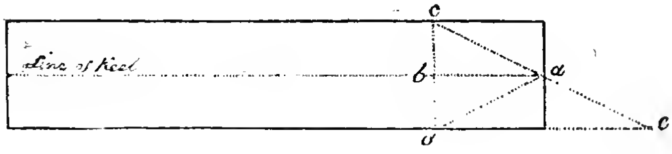
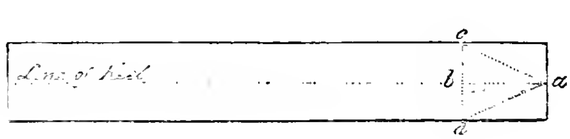


Fig. 2.



Suppose it were required to reduce their resistance by one half, preserving to the wider vessel her advantage of 7 to 9. Let fig. 1 represent the vessel of 40 feet beam, and fig. 2 that of 30. To effect the required reduction, we have simply to employ the principle of the wedge, and making $a\ b$ in each figure equal to $c\ d$, in the same we have $b\ a$, the velocity of the vessel, equal to twice $b\ c$, the velocity of the weight which represents the resistance of the water to the motion of the vessel in the direction $b\ a$. For the weight or resistance of the whole surface $c\ d$ is divided into two equal parts on the surfaces $a\ c$, $a\ d$, and these two halves being each moved the distance $b\ c$ or $b\ d$, while the vessel moves the distance $a\ b$, a power is shown exactly equivalent to that of a wedge $c\ a\ e$ in fig. 1. I state this thus fully because some writers on mechanics, as Emerson for example, make it appear that though the direction of the power be that of the line $a\ b$, it is to be calculated on the proportion which $c\ d$ bears to $a\ b$, instead of that borne by $c\ b$ or $b\ d$, the half of $c\ d$.

The vessels are thus reduced in their bulk or tonnage by the amount of a rectangular prism equal in its upper surface to the parallelogram $c\ b$, $b\ a$, and, (as we are at present considering only the immersed portion of their hulls,) of the immersed depths of each, viz., 15 feet in fig. 1, and 20 feet in fig. 2. Now $a\ b$ is in each equal to the beam of the vessel, and $c\ b$ equal to half $a\ b$, therefore the cubic contents of the parts removed are in fig. 1, $40 \times 20 \times 15 = 12,000$ cubic feet, and in fig. 2, $30 \times 15 \times 20 = 9000$ feet, giving a difference of 3000 feet, which divides exactly 40 times into 120,000, the total cubic contents of each vessel; thus by the sacrifice of $\frac{1}{40}$th part of the immersed portion of her body, we preserve to the vessel of greatest breadth her advantage in point of speed of 7 to 9, together with the other good qualities which I shall hereafter show to attend her proportions, by the alteration of form in the horizontal direction alone. We have next to consider how the relative merits of the two vessels will stand if it be required to give the same speed to both with the same power. Their relative resistances being as 7 to 9, we will suppose that the velocity attained by the narrower vessel with a given power is sufficient for the wider; to reduce the latter to the speed of the former, we again have recourse to the principle of the wedge, by making *a b* bear the same proportion to *c d*, or 10 feet as 7 to 9. We thus find as 9 : 7 : : 40 : 31·11; then *b c* 20 × 15 (the depth) × 31·11 = 9333 cubic feet, the amount by which the bulk of the wider vessel is decreased to attain the same speed as the narrow one. But the latter was shown to lose only 9000 cubic feet of her bulk by this means, and she has still therefore an advantage of 333 feet over the wide vessel, 333 will divide about 360 times into 120,000, therefore the wide vessel sacrifices 1-360th part of her bulk more than the narrow one to attain the same speed by alteration of her horizontal form; but this amount is so small as to be quite inconsiderable, for in a vessel of 2000 tons burthen the difference will be but $3\frac{1}{18}$ tons.

Thus much as to the diminution of resistance by alteration of the horizontal form; let us now inquire how the same effect may be produced by altering the vessels in their vertical section. Let fig. 1* represent the vessel of 40 feet beam, and fig. 2* that of 30, in elevation, or longitudinal section. The depth *a b* equals 15 feet in fig. 1*, and 20 feet in fig. 2*. To reduce their respective resistances as before to one half, we make *b c* equal to twice *a b*, viz., 30 feet in fig. 1*, and 40 feet in fig. 2*. They are then reduced in bulk as follows: fig. 1* by 15 × 15 × 40 = 9000 cubic feet, and fig. 2* by 20 × 20 × 30 = 12,000 cubic feet, showing a difference of 3000 cubic feet in favour of fig. 1*, being exactly what was lost when reduced in her horizontal form to give the same results. Again, to reduce the speed of fig. 1* to that of fig. 2*, make *b c* : 30 : : 7 : 9, thus *b c* = 23·33 feet, and $\frac{23{\cdot}33}{2} \times 15 \times 40 = 6999$ cubic feet, making a difference in bulk of 5001 cubic feet in favour of fig. 1*, at the same velocity as fig. 2*. Comparing these results we see that giving the wider vessel the same speed as the narrow one, she lost 333 cubic feet more of her bulk than the latter, by doing the same by change of form vertically she has an advantage of 5001 cubic feet.* As it is almost always necessary to employ both these methods of reducing a vessel's resistance, I shall suppose them equally applied, and deducting the loss from the gain we have still 4668 cubic feet of bulk remaining for buoyancy or stowage in favour of the wider vessel when the two have the same velocity: and as the loss in preserving her advantage of 7 to 9, by change of horizontal form exactly equalled her gain in doing so by the vertical alteration, if both means are equally employed we find she preserves her advantage in speed without any loss of bulk whatever beyond the narrow vessel, and, as I think can be proved, with many points of superiority in other respects. I have considered these effects as applied to bodies of simple parallelogramic forms in the first instance for the sake of simplicity of illustration, but the principle is applicable to all forms; and as regards vessels with sharp bottoms, and of a breadth of beam say equal to the wider vessel supposed above, and of a draught equal to the narrow one, their resistance may be resolved into that of parallelograms depending in their proportions of depth and width on the acuteness or obtuseness of the angle which their bottoms make at the keel, and on the depth of their bilge or union of the sides and bottom below the water line. I shall have occasion again to refer to this part of my subject when I come to speak of the comparative stability of vessels of different transverse sections. At present I shall only remark that the results of the above calculations are fully borne out by all the seagoing steamers I am acquainted with. For instance, the Gorgon and Cyclops of 1200 tons burthen and 320 horse power, having good beam, have performed excellently; while the Liverpool, in her first state of 1042 tons burthen, and 460 horse power, through great deficiency of beam, was a miserable failure; but since her alteration, though greatly increased in tonnage by the addition of 7 feet beam, she gives more satisfactory results with the same power than any of the large steamers built for crossing the Atlantic. The Great Western registering 1340 tons, and of 450 horse power, having pretty fair beam, was the only one of the New York steamers which could be said to answer, until the Liverpool was altered, since which time the latter seems to have the advantage. The British Queen and President have completely nullified the calculations of their projectors, and Mr. Cunard's steamers, almost equally deficient in this respect, employ about 500 horse power to do what, judging from past experience, the Gorgon* and Cyclops would in all probability easily effect with 320. I think these results, independently of others which, with your permission, I shall hereafter adduce, are sufficient to prove the fallacy of the almost universal belief among shipbuilders and others that narrow vessels are necessarily faster than those of greater beam. So strongly however is this opinion held, that I know that shipbuilders of considerable experience and ability have declared that no steamer should have beam in a larger proportion to her length than as 2 to 13; or in other words should have no less than $6\frac{1}{2}$ breadths to her length; a proportion which has proved insufficient in most of the points which I named as necessary for a seagoing steamer: and for the sake of this dogma though sometimes giving their vessels very good horizontal lines, they sacrifice all the advantages they might obtain by a proper application of the reduction of body vertically, and are obliged from their want of beam, to trust to the enlargement of their bows above water to prevent their constantly shipping water forward, involving defects which I shall endeavour to make clear if I continue the subject. The subject of long narrow steamers of small draught in proportion to their beam, which have had many advocates, will occupy another part of our consideration, and I refer to it here merely to say that it is not overlooked. I believe the late system of computing tonnage for shipping has had a great share in producing the defect in point of beam which is to be observed both in our sailing merchant vessels and in our mercantile steamers; for in consequence of the gross absurdity of assuming a fixed proportion of depth for every vessel, namely, half of their measured breadth, and 94 as the divisor for reducing the cubic result of the three dimensions to tons, however different in form the vessels might really be. Merchants and shipbuilders universally endeavoured to gain as much as possible on their registered tonnage, by giving depth beyond the imaginary standard, and a form fore and aft which should give an absolute amount of bulk much above the $\frac{4}{10}$ths of the parallelogramic solid which were supposed, by the use of 94 as a divisor, to remain after reducing the vessel by the sharpening of her bottom, entrance, and run. This style of building has been frequently carried, as too many fatal instances have proved, far beyond the limits of safety, while vessels of really good proportions and fine form being registered by this method of a much greater tonnage than their real burthen, had an absolute fine in the shape of duty imposed on their good qualities.—In the fruit trade and others especially requiring speed, this has led to the building of deep narrow vessels sharp forward, and lean and hollow abaft, gaining somewhat in tonnage, but wanting in all really good qualities, being the wettest and most uneasy vessels which leave our ports. The numerous beautiful models which have fallen into the hands of our merchants as slave prizes have for the same reason, almost without exception, been lengthened and raised upon, have had all their fine points destroyed, been greatly reduced in speed, and frequently become exceedingly unsafe vessels, as was the case with a most beautiful slave schooner sold for the turtle trade in this port a few years ago, which having been raised upon, lengthened, and square rigged, went to the bottom on her second voyage. Since the passing of the New Tonnage Act, which assigns as nearly as possible the real contents of a vessel for her register, it might have been expected that some improvement would have taken place in the models leaving the stocks in our merchant builders' yards, but so strong is habit, especially bad habit, and so rooted is prejudice, particularly in matters where expediency and not principle has been the ruling power, that hardly any use has been made of the advantages offered by the new act, and our

Fig. 1.

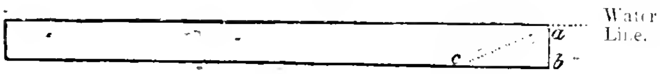
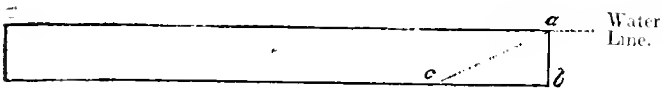


Fig. 2.



* The American river steamers referred to in the conversation at the Civil Engineer's Institution on Mr. Seaward's table of velocities, are described as diminished principally in the vertical direction; they have been aptly described as having "spoon entrances."

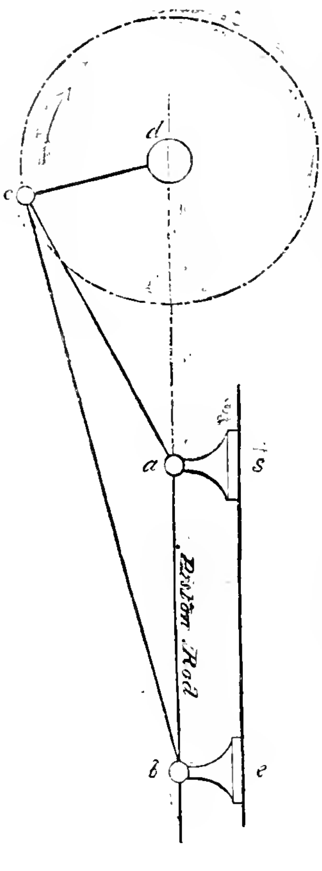
† See C. E. and A. Journal, vol. I, p. 385.

newly built merchant ships, in general, present no more satisfactory aspects than their predecessors; and the proportions published as those of the new steamers building in Scotland for Government, are a further illustration of this position.* Unfortunately this defect has influenced the docks intended for the reception of merchant steamers, and unless the gates of those in this port were increased in width they would not admit steamers of the same tonnage as those now using them, but of greater beam.—Having trespassed at so great length on your space, I beg to observe in conclusion, that my reason for having cited no authority in support of my views is simply that I have met with none taking the same ground; and of those treating on this subject under any aspect, the older ones are generally very vague and general in their statements; and the more modern, though entering at great length and with much pains into particular forms, are so partial in their manner of considering the matter, that of the two whose opinions have latterly carried most weight, I have found one advocating the construction of seagoing steamers twelve times as long as they are broad, and the other predicting the time when masts and sails would be considered mere useless incumbrances, and our line-of-battle ships be used only as coal transports for steamers. Such ideas indicate any thing but a comprehensive mode of viewing this subject, and not trusting much to the assistance to be derived from such sources I have preferred merely stating the result of my own observations, relying on the candid consideration of those who are practically interested in this matter.

I am, &c.,

H. P. H.

ON LONG AND SHORT CONNECTING RODS.



Sir—Perceiving in your excellent Journal for this month, an article respecting long and short connecting rods, wherein it is stated that the short connecting rod is as effective as the long one, I take leave to send you a diagram, which will perhaps show that there is a greater amount of friction with the short connecting rod.

The accompanying figure represents the direct connection with the piston of a long and short connecting rod. In this case it is clear that the long rod *c*, *b*, is working always nearer the *parallel line* of the piston than the short rod *c*, *a*, or that the short rod is pushing against the slide *s*, *e*, at a much greater angle than the long one, and consequently that there must be less friction at *e*, than at *s*, therefore as the angle *c*, *a*, *d*, is greater than the angle *c*, *b*, *d*, so is the friction at *s*, greater than the friction at *e*. The same results will be found with common marine and all other engines, only that where slides are used there is always a much greater amount of friction than upon centres. I am however of opinion, that a short connecting rod, with a direct connection with the crank, might be used with greater effect than a longer one in the common marine engine, where heavy side levers are kept continually reversing their motion, besides the extra weight which the boat has to carry.

I am, Sir, your most obedient servant,

J. F.

London, July 12.

Sir—In your July number you have a letter from Mr. Daniel Clark on "Long and short connecting rods," in which he arrives at the conclusion that "upon the whole, then, short and long connecting rods on the same length of crank must be equally effective, whatever peculiarities there be." In this, however, I do not concur with him and would recommend him to re-consider the subject and see if really the force (see Mr. Clark's first figure) D C or E M be of no consequence; I think he will find it to be of the greatest consequence, and to be together with the analogous force of pressure on the other journals, the reason why long connecting rods always have been and always will be preferable, and why, moreover, an engine, the connecting rod of which bears to the length of the crank a ratio less than a certain quantity, would not work at all. Mr. Clark would find it very interesting to consider minutely the case in which the length of the connecting rod is equal to the length of the crank, he will find that the strength required for the paddle-shaft, the connecting rod, all the journals, the framing, and in fact the whole engine, is what may probably startle him.

I am, Sir,

Greenock, July 5. Your obedient servant,

J. G. L.

MR. PARKES NEW THEORY OF THE PERCUSSIVE ACTION OF STEAM.

Sir—Feeling some interest in Mr. Parkes' new theory of the percussive action of steam in the Cornish engines, might I offer a few remarks on the former part of a paper which appeared in your Journal for this month. The writer of that paper appears from his remarks at the beginning, to have an opinion that Mr. Parkes has rather favoured the Cornish engines, in considering that the percussive force of steam is only developed in them; and he remarks that if such a property does exist in the steam, we might expect to find it more fully developed in the case of the locomotive engines; for he says, "though why he considers it to operate in these engines only, we know not; we are of opinion that if it obtains in them, it should obtain *à fortiori* in locomotives, where the density and velocity of the steam entering the cylinder are so much greater."

The object of the following remarks is to try to show that the Cornish single-acting engines are the only ones at present in which the percussive force of steam could act with any very great advantage; and that the locomotives are the very worst engines in which it could be used as a moving force.

We will first of all take the case of a common double-acting rotative engine. In these engines the slide is so adjusted as to let the steam into the cylinder when the piston is either at the top or bottom of its stroke; and consequently, when the crank is just passing the centre. Now this being the case, it is evident that any percussive force of the steam striking upon the piston would be injurious rather than benefit the engine, as it could not by any means have any effect in turning the crank, but, on the contrary, only create an additional wear and tear of the different working parts, on account of the violent jerk which would be the effect of its striking upon the piston while the crank is in such a position as not to let it recede before the blow. In this engine, then, as at present constructed, we must not expect to find any very great economy by bringing this force into action.

In consequence of the rapidity with which the strokes of the piston in a locomotive follow one another, it is found necessary to admit the steam into the cylinder before the piston has finished its stroke, for two reasons: 1st, it is found necessary to admit the steam into the opposite side of the piston before it has finished its stroke, in order to bring it gradually up to the stop, and to diminish the violent jerk that would be occasioned by its motion being so rapidly changed, and 2ndly, so that it may be ready to act as soon as the piston has finished its stroke. This being the case, the percussive force of steam would act still worse here than in the before-mentioned case, as it would, instead of helping to impel the piston, actually impede it, if not stop it altogether. In this case, as well as in the former, the percussive action is altogether avoided by the gradual motion of the slide, for as soon as the slide begins to open the steam way, the steam rushes into the cylinder and strikes upon the piston, but with very little effect, on account of its being so much wire drawn in consequence of the small size of the opening at first.

In order to render the percussive force of steam available to its fullest extent as a moving power in single acting pumping engines, it would be necessary to have some medium interposed between the direct action of the steam on the piston and the pumps; so as to convert the ever-varying pressure on the piston into a regular and steady pressure on the plunger of the pump. This I think will be clearly seen, for if we suppose for an instant this medium not to exist, such as

* The Forth has lately arrived in Liverpool, and fully confirms the above opinion; proving with two steamers lately sent hither from Hamburg, that the examples of the Liverpool, British Queen and President have not influenced their builders in assigning the proportions of breadth and depth.

the momentum of the different parts of the engine, the pump rod, and the column of water set in motion; we must come to the conclusion that as the pressure on the piston varies without any medium to equalize its effect, the resistance opposed to the pump plunger ought to vary also.

In the common single acting pumping engine this medium is in a measure supplied by the weight of the pump rod, which is made sufficiently heavy to overcome the friction of the engine, and to raise the piston at the return stroke, and by the momentum of the beam and other parts of the engine; and also by the momentum of the column of water before it enters into the air vessel; these however would form but a very small reservoir for the immense pressure at the commencement of the stroke, so that in these engines the application of the percussive force must be very limited, in consequence of the pump rod not being of a sufficient weight to accumulate all the overplus power at the commencement of the stroke, so as to impart it to the plunger when the pressure on the piston, in consequence of the expansion of the steam, falls below the resistance on the plunger so that the percussive force would be in a great measure entirely wasted. Again on the other hand, if the rod which generally weighs from 8 to 9 tons, were made heavier, so as to equalize to a great extent the pressure on the plunger, it would be more than necessary to overcome the resistance of the engine at the return stroke, and so occasion a loss of power.

The action of the Cornish single acting engine is somewhat different from that of the common one, the pressure of the steam on the piston instead of being applied directly to work the pumps, is applied to raise a pump rod of sufficient weight to work the pumps at the return stroke. The result of this difference of arrangement is that instead of having a pump rod of 8 or 9 tons weight, we get one of from 20 to 70 tons weight according to circumstances. Here then we get an immense mass of matter amply sufficient to accumulate all the overplus power at the commencement of the stroke, and to return it as required at the end of it. The action of it is this: the steam being admitted suddenly into the cylinder strikes upon the piston at rest with a considerable force above what is due to its elastic pressure alone, and sets this massive pump rod in motion; the steam in the cylinder expands, and consequently acts with less force on the piston, and the pump rod after the pressure of the steam on the piston, becomes insufficient of itself to raise it any higher, assists to carry itself through the remainder of the stroke, by means of the power that it accumulated at the commencement. When the rod is thus as it were thrown up to the top of its stroke, the equilibrium valve is opened and the weight of the pump rod descending acts upon the plunger of the pump and raises the water. In this engine then we have the means of applying the percussive force of steam to almost any extent in cousequence of the weight of the pump rod, which acts as a reservoir for the power that would otherwise be wasted.

These remarks I think have clearly shown that in the common double acting engine the percussive force of steam could not be made to act with any advantage, but would, on the contrary, occasion an additional wear and tear; that in the locomotive it would act still worse, and would actually impede the engine, if not stop it altogether; that in the common single acting pumping engine it could only be brought into useful action in a small degree; and that in the Cornish engine we might use it as a moving force to a very considerable extent.

When we consider the amazing quantity of work done by the Cornish engines as compared to any other, we are perfectly at a loss to account for the difference, and are brought to the conclusion that there must be some force in the steam which can only be applied to any considerable extent in those engines, and which will not allow of being so applied in any others. The elastic force of steam can be applied in any sort of engine, the expansive force can be applied economically in all, but more so in the Cornish than any other engines; but still this is insufficient to account for the difference of the amount of duty done. The only other force that we can conceive the steam to possess is that which Mr. Parkes has denominated its percussive force. If the conclusion drawn from the preceding remarks be just, we see that the Cornish engines are the only ones in which this force could be applied to any considerable extent.

It also stands to reason that if this force does exist in the steam, and if it was usefully applied it would increase very considerably the duty done. It is also now a fact well ascertained that the Cornish engines will do three times the duty of any other with the same expenditure of fuel.

Is it not then reasonable to infer that as the Cornish engines are the only ones in which the percussive action could be employed to any considerable extent, and that they alone perform that additional work that would be the effect of this force if usefully applied, we may safely conclude (if all other evidence was wanting), that this percussive force does actually exist in the steam, and that it in a great measure will account for the quantity of work done by these engines.

Hoping that these observations may help to throw a little light on the subject, and may induce some of your readers who may have the means, to pay a little attention to the subject.

I remain, Sir, your's, respectfully,

C. S.

Bankside, Southwark,
August 13, 1841.

ON THE MOMENTUM PROPOSED BY MR. JOSIAH PARKES, AS A MEASURE OF THE MECHANICAL EFFECT OF LOCOMOTIVE ENGINES.

By the Count De Pambour.

In the *Transactions of the Institution of Civil Engineers*, vol. III, Mr. J. Parkes has published a paper *On Steam-boilers and Steam-engines*, in which the object s to propose, as a new measure of the mechanical effect of locomotive engines, what he calls the *momentum* produced by the engine, that is to say the product of the mass, in tons, of the engine, tender and train, multiplied into its velocity, in feet per second. According to him, this momentum being measured at one velocity, for a given engine, the effect of the same engine, at any other velocity, will be immediately deduced from it by a single proportion (page 130), without troubling one's head about the inclination of the road, the friction of the wagons or the engine, the counter-pressure due to the blast-pipe, the resistance of the air, or, in fact, any of the resistances really encountered by the engines.

To establish this new idea, Mr. Parkes' first step is to represent as altogether faulty and impossible every calculation or experiment made by others, to take account of the divers resistances offered to the motion of the engines. With this view he enters into a long and malevolent discussion on the experiments of our *Treatise on Locomotive Engines*, and on all the experiments on the same subject published by different engineers; and to demonstrate the difficulties insurmountable, in his opinion (page 124, 129), and the uncertainty attending such researches, he indicates several verifications which, as he says, these experiments ought to satisfy, and which they do not satisfy. As Mr. Parkes gives on the subject a great number of arithmetical calculations, the errors of which are protected against detection by the heap of figures presented, we shall first enter, with some detail, into the examination of his pretended verifications, and afterwards shall discuss the value of the new measure proposed by him to represent the mechanical effect of locomotive engines.

On seeing the *fundamental* errors on which his reasoning and his calculations are grounded, the inaccuracy of his criticisms and of the results at which he has arrived, will be at once recognised.

1st. Mr. Parkes proposes to calculate the pressure at which the steam was necessarily expended on the cylinder of each engine submitted to experiment, in order afterwards to compare that pressure with the pressure resulting from the sum of the different determinations of resistances exerted against the piston, according to the *treatise on locomotive engines*. With this view, he seeks, from the velocity of the engine, the number of cylinders full of steam which were expended per minute. Comparing the volume thus obtained to the volume of water vaporized in the boiler, he concludes the *relative* volume of the steam during its passage into the cylinder; and finally, recurring to the table of the relative volumes of steam under divers pressures, contained in our *Theory of the Steam Engine*, he concludes the pressure which the steam must necessarily have had (page 82, &c.) This is conformable to our theory developed in the *Treatise on Locomotive Engines*, which, in fact, Mr. Parkes entirely adopts. But to perform this calculation, Mr. Parkes takes the *average* velocity of the whole trip from Liverpool to Manchester (page 85, and table viii., col. 10; table xiii., col. 9; table xvi., col. 2, &c.), and from that velocity he pretends to deduce the *mean pressure* of the steam in the cylinder during the same trip. Now it will be easy to prove by an example that this mode is altogether faulty.

Suppose, in effect, the engine Atlas has travelled a distance of 30 miles in an hour and a half, vaporizing 60 cubic feet of water per hour. As the wheel of the engine is 5 feet in diameter, or 15·71 in circumference, as there are two double cylinders-full of steam expended at every turn of the wheel, and as the capacity of those two double cylinders, including the filling up of the steam ways, amounts to 4·398 cubic feet, it follows that the volume of the steam which passes into the cylinders per mile performed, or per distance of 5280 feet, is

$$\frac{5280}{15{\cdot}71} \times 4{\cdot}398 = 1178 \text{ cubic feet.}$$

This premised, when Mr Parkes refers to the average velocity of the whole trip, to value the pressure in the cylinder, as that velocity is 20 miles per hour, and as the vaporization at the same time is 60 cubic feet of water per hour, he finds, for the ratio of the volume of the steam expended to the volume of water, $\frac{1478 \times 20}{60} = 492{\cdot}7$. Consequently, recurring to the table of the relative volumes of steam under different pressures, he obtains for the corresponding total or absolute pressure 56·66 lb. per square inch; and deducting the atmospheric pressure, he obtains for the effective pressure, 41·95 lb. per square inch.

But to show that this mode of calculating, from the average velocity, can only lead to error, let us suppose that, by reason of the divers inclinations of the portions of the railway, the first 15 miles have been traversed in half an hour, and the other 15 miles in an hour, which still makes 30 miles in an hour and a half; as 30 cubic feet of water will have been vaporized in the first half hour, or during the passage of the first 15 miles, and 60 cubic feet of water during the next hour, or in the passage of the last 15 miles, it is plain that the volume of the steam will have been respectively in each of those times $\frac{1478 \times 15}{30} = 739$ first, and afterwards $\frac{1478 \times 15}{60} = 369{\cdot}5$. Whence results, according to the table, that the effective pressure of the steam will have been successively 21·62 and 62·95 lb. per square inch.

Thus, during the first half hour the effective pressure will have been 21·62 lb.; during the second half hour it will have been 62·95 lb., and during the third again 62·95 lb. Consequently, taking account of the time during which the pressure has had these respective values, it is plain that the mean effective pressure in the cylinder will really have been $\frac{21{\cdot}62 + 62{\cdot}95 + 62{\cdot}95}{3} = 49{\cdot}17$ lb. per square inch, and not 41·95 lb. per square inch, as given in Mr. Parkes's calculation; which, by the fact, supposes all the portions of the trip to have been performed in equal times. In this case, therefore, which has nothing in it but what is very ordinary, there would be an error of 7·22 lb. per square inch out of 41·95; that is an error of more than $\frac{1}{6}$ on the effective pressure of the steam. It is evident that the calculation, such as Mr. Parkes makes it, is exact only for portions of road composed of one inclination, or travelled with *uniform* velocity, and that it cannot apply to the total passage of a line composed of different inclinations. For further elucidation on this head, we refer to chapter XVII., relative to inclined planes, of our *Treatise on Locomotive Engines*, 2nd edition, and to chapter XII. of the same work, in which all the experiments considered by Mr. Parkes are calculated.

2nd. We have just shown the first error which Mr. Parkes introduces, as a fundamental basis, in his calculation of the pressure of the steam in the cylinder. But he does not stop there. In the table of experiments on the vaporization of the engines (*Treatise on Locomotive Engines*, page 175 of first edition, and page 253 of second edition), we have given the average velocity of the engines during each trip; and that velocity is obtained simply by dividing the whole distance performed, by the time employed in performing it, as is seen in the table in question. It would be natural then for Mr. Parkes, who, as has been said, is satisfied with average velocities in his calculations, to take those which are given in the table; but instead of that, he augments almost all the velocities about $\frac{1}{5}$. Thus, for instance, the VULCAN, which travelled 29·5 miles in 1 hour 17 minutes, and whose average velocity in consequence was stated to be 22·99 miles per hour, had, according to Mr. Parkes, a velocity of 26·90 miles per hour. The velocity of the VESTA rises from 27·23 to 31·60 miles per hour, and so of the others (table viii., col. 10; table xiii., col. 9; table xvi., col. 2). The critic falls into this new error because, in the *Treatise on Locomotive Engines* (page 324 first edition, and page 311 second edition), in speaking of fuel, it is said that, when the engines ascend without help the inclined planes of the Liverpool and Manchester Railway, the surplus of work, thence resulting for them, equals, on an average, the conveying of their load to $\frac{1}{5}$ more distance, and Mr. Parkes logically concludes from this that the *velocity* of the engine must be by so much increased (pages 86, 112). So that if an engine perform 1 mile in 4 minutes, ascending a plane inclined $\frac{1}{89}$, which renders nearly five-fold the work of the engine, it would follow, from this calculation, that the velocity would not have been 15 miles per hour, but $15 \times 5 = 75$ miles per hour, since the quantity of work done would have been five-fold! Mr. Parkes's error proceeds from his having applied to the velocity a correction which refers only to the *work* done, and, as a consequence, to the corresponding consumption of *fuel*.

But on examining what effect results from this substitution of the imagined velocity of Mr. Parkes for the observed velocity, it will be remarked that whenever an engine is obliged to ascend without help one of the inclined planes of the Liverpool and Manchester Railway, it exerts at that moment, as we have said, an effort five times as great as upon a level, and draws its load less rapidly. One would deem it then allowable to conclude, that the average pressure of the steam in the cylinder must be augmented, since during a certain portion of the trip, the effort required is greater, and that the *useful* effect per unit of time must be diminished, since during the same time the useful load is drawn at less velocity. But no. Mr. Parkes's calculation, by augmenting, then, the apparent velocity of the engine, demonstrates that, in this case, the average pressure in the cylinder becomes on the contrary much *less*, and that the useful effect becomes much *greater*. So that the error committed produces itself here in the two opposite ways.

With these elements Mr. Parkes establishes the *whole* of his calculations and tables, to the very end of his paper (table viii., col. 10; table ix., col. 19; table xiii., col. 9; table xiv., col. 2; table xvi., col. 2); and as, to augment the evil, this pretended correction is made only on one portion of the experiments, namely those in which the engines were helped up the inclined planes, without being made in the other cases, there results an inexplicable confusion in all the calculations. Thus, it happens that Mr. Parkes's determination of the volume and pressure of the steam consumed by the engines (table ix., col. 26, 29), the horse power produced per cubic foot of water vaporized, or the quantity of water employed to produce one horse power (table x., col. 44, 45, 49, &c.), the momentum generated per pound (table xiii., col. 11, 12; table xiv., col. 9, 10, 11), and all the consequences thence derived are in every way erroneous.

To show by a particular example, the fallacy of the results to which Mr. Parkes has been led by this wholesale and faulty way of calculating, we need only refer to the two experiments of the FURY, which he extracts from our work on locomotive engines. He pronounces, "with certainty," (page 128), these two experiments to be erroneous, as exhibiting an engine performing more work at 23 than at 21$\frac{3}{4}$ miles per hour, in the ratio of 21 to 19. Now, to arrive at this conclusion, Mr. Parkes first takes the velocity of the engine, not at 18·53 and 19·67 miles per hour, as given from actual observation, page 175 of the first edition, and pages 253 and 392 of the second edition of our Treatise on Locomotive Engines, but at 21·79 and 23 miles per hour (table xiii., col. 3). Secondly, in comparing the work done in the two trips, he does not take into account that the first of the two trips has been made from Manchester to Liverpool, and the second on the contrary from Liverpool to Manchester. But there is a general rise of the ground from Manchester towards Liverpool, and from that circumstance, the gravity opposes more resistance in that direction than in the contrary one. Thus it happens that a less train carried on the line from Manchester to Liverpool, may require from the engine, a greater quantity of labour than a heavier train carried in the opposite way. In effect, by referring to pages 501 and 504 of the second edition of our work on locomotives, it will be found that in the two experiments under consideration, the work done by the FURY, in carrying the two loads of 43·8 and 51·16 tons, besides tender, from Manchester and from Liverpool respectively, to the other end of the line, was

43·8 tons, from Manchester to Liverpool, equal, gravity included, to - - - 1964 tons to 1 mile.
51·16 tons, from Liverpool to Manchester, equal, gravity included, to - - - 1837 tons to 1 mile.

We see, therefore, that when we take an account, as we ought to do, and as Mr. Parkes has not done, of the surplus of labour caused by gravity, the work required of the engine is in reality more in the first case than in the second, although the load itself is less. Consequently the engine ought to have accomplished the second trip in less time or with a greater average velocity than the first, which in fact it did, and which had led Mr. Parkes to pronounce with such "certainty" the experiments to be erroneous.

This example shows that the calculation of Mr. Parkes, made with an erroneously averaged and exaggerated velocity, in which, moreover, he omits the gravity on the inclined planes, the resistance of the air, the friction of the engine, and all the other resistances really opposed to the motion, leads him to a *very inaccurate* measure of the work performed by those engines; and this refers to the whole of the results obtained, table ix., col. 29—32; table x., col. 41—50; table xiii., col. 11, 12; table xiv., col. 9, 10, 11; table xvi., &c., and also to his comparison of locomotive and stationary steam engines, which we shall notice further on.

3rd. After having calculated *very exactly*, as we have shown, the pressure of the steam in the cylinder, Mr. Parkes compares the result which he has obtained, with the total pressure on the piston resulting from the partial resistances suffered by the engine, according to the *Treatise on Locomotive Engines;* and as, in the first edition of that work, the author had confined himself to mentioning the pressure against the piston due to the action of the blast-pipe, without making any experimental research on the subject, Mr. Parkes, without noticing the results presented since in the *theory of the steam engine*, (page 161), takes the difference between the two results, as necessarily expressing the pressure due to the blast-pipe (pages 82, 83); and he demonstrates the inaccuracy of it. Here we perfectly agree with him; for, besides the errors already pointed out in his research of the pressure of the steam in the cylinder, every thing variable that can occur in the different data of resistance, now passes to the account of the pressure due to the blast-pipe, and must necessarily come to falsify the calculation of it. Thus, for instance, in the experiments, a great deal of water was lost by *priming*, and there resulted an apparent vaporization greater than the true one. A part of the difference between the calculated and the observed pressure was therefore to be attributed to that cause, though it could not be accurately measured; but, by the calculation of Mr. Parkes, it all passes to the account of the pressure due to the blast-pipe. Similarly, the resistance of the air, then imperfectly computed in the total resistance for an average velocity of about 12 miles per hour, is found, in all cases of greater velocity, to augment considerably the pressure due to the blast-pipe, and on the contrary to diminish it in all cases of less velocity. A favourable or an unfavourable wind necessarily produce similar effects. Thus, circumstances, combined with the fundamental errors already introduced in the calculation, raise or lower that pressure to all imaginable degrees (pages 87, 88, 90, 91); and it will be readily imagined that such a determination cannot be exact.

4th. Mr. Parkes has observed, in the experiments of the *Treatise on Locomotive Engines*, and particularly in two of them, made with the LEEDS engine, and quoted in the *Theory of the Steam Engine*, that the useful effects produced by the same quantity of water vaporized varies according to different circumstances, and he is amazed at it; for, as he affirms, the useful effects produced by the same quantity of water vaporized, in the same time and under the same pressure in the boiler, ought in all cases to be identical (pages 104, 119). But this again is merely an error of the critic; for if we suppose a locomotive engine drawing a heavy load at a small velocity, since it is only at a small velocity that the engine has to overcome its friction, as well as the atmospheric pressure against the piston, and, above all, the resistance of the air against the train, it follows that out of the quantity of total work executed, there will be but a trifling portion lost in overcoming those resistances; but if, on the contrary, we suppose the same engine performing precisely the same quantity of *total* work, but drawing a light load at a great velocity, it is obvious that a much greater part of the work done will be absorbed in moving, at that velocity, the resistance which represents the friction of the engine, as well as the atmospheric pressure against the piston, and in overcoming the resistance of the air, which increases as the square of the velocity; and consequently there will remain a much smaller portion of it applied to the producing of the useful effect. Hence, in the two cases considered, the useful effects produced by the same quantity of water vaporized, so far from being identical, will, on the contrary, be very different from each other. Mr. Parkes may, besides, satisfy himself on this point, by perusing the *Theory of the Steam Engine*, in which he will find numerous examples of steam engines, in which the useful effect of one cubic foot of water varies in very wide limits, according to the velocity of the motion or the load imposed on the engine; and he will find it explained theoretically in chapter XII. of the *Treatise on Locomotive Engines*, or in chapter III. art. II, of the *Theory of the Steam Engine*. Thus Mr. Parkes's reasoning errs again by the basis itself.

5th. But there is another principle to which Mr. Parkes would subject all the observations of vaporization of locomotive engines. He remarks that in the two experiments above cited, the total resistance opposed to the motion is different in the two cases. Consequently, says he, the quantities of water vaporized by the engine in the same time must be in proportion to the pressures in the cylinder, and the experiments ought to satisfy this condition (pages 90, 100). Upon this point he is merciless.

To establish this new principle, Mr. Parkes recurs to the *Treatise on Locomotive Engines* itself. He quotes a passage in which, supposing same engine travelling the same distance with two different loads, the author says positively that the distance travelled being the same in both cases, the number of turns of the wheel, and consequently the number of strokes of the piston given by the engine, that is to say, the number of cylinders full of steam, or finally the total volume of steam expended, will also be the same in both cases; whence results that the same volume will successively have been filled with two steams at different pressures, or in other words, at different densities; and consequently the quantities of water which have served to form those steams will be in proportion to their respective pressures (page 310—312 of the first edition). Thus, this passage establishes very distinctly that the quantities of water vaporized, *for the same distance*, are in proportion to the pressures of the steam in the cylinders. But what does Mr. Parkes conclude from this? Why, that the quantities of water vaporized *in the same distance* are in proportion to the pressures in the cylinder. Now it happens to be just the contrary; for, if we suppose, by way of example, the two pressures to be in the ratio of 2 to 1, the volumes of water vaporized for the same distance traversed, will also be in the ratio of 2 to 1; but if the time employed in performing the distance in question be two hours in the first case, and one hour in the second, it is plainly the quantities of water vaporized in two hours and in one hour respectively, which will be one to the other in the ratio of 2 to 1, so that the vaporizations per hour, or *in the same time*, will be equal instead of being in the ratio of the pressures. Thus it is clear again that Mr. Parkes's principle rests but on a new error, which consists in making a confusion between the vaporization for the same distance and the vaporization for the same time.

6th. A final observation of Mr. Parkes (pages 89, 90, 98), is this, that in some experiments, the locomotive engines produced, for the same quantity of water vaporized, a greater useful effect than several stationary high-pressure steam engines, or even than several condensing steam engines; and he considers this result as a proof of the inaccuracy of those observations; for, says he, the locomotive engines having to contend with the pressure arising from the blast-pipe, which the high pressure engines have not, and also with the atmospheric pressure, neither of which resistances the condensing engines have to contend with, it is incontestable that they cannot even produce equal effects, much less superior ones (page 104). But this reasoning is as unfounded as those we have already noticed; for, since the useful effect of steam engines, for the same vaporization, diminishes as the velocity of the motion increases, which has been already explained above, and which is found developed, either in chapter XII. article II. of the *Treatise on Locomotive Engines*, second edition, or in chapter III. article II., section 1, of the *Theory of the Steam Engine*, it is easy to conceive that a locomotive working, for instance, at its maximum useful effect, that is to say, with its maximum load, and consequently at a very small velocity, at which the pressure due to the blast-pipe and the resistance of the air are nearly null, can produce a useful effect greater, nay much greater than a stationary high pressure engine, working on the contrary with a light load and a great velocity. The same inferiority of effect may also occur in a condensing engine, because an engine of that system working, for instance, at 16 lb. pressure per square inch in the cylinder, and condensing the steam to 4 lb. per square inch *under the piston*, where the pressure is always greater than in the condenser, loses, by that fact alone, a quarter of the power which it applies: whereas a locomotive, working at 5 atmospheres in the cylinder, and at a very small velocity, which renders almost null the pressure due to the blast-pipe, suffers, by the opposition of the atmospheric pressure, a loss equal to only $\frac{1}{5}$ of its total power. Hence, definitively, in the latter engine, the counter-pressure against the piston destroys a smaller portion of the total power applied, and consequently, without even noticing the difference of friction of the two engines, or entering into any other consideration relative to the velocity, it is conceivable that the useful effect of the locomotive may be found greater.

But if a more complete calculation be desired, it will be easy to furnish it; for the relative volume of the steam at 16 lb. pressure per square inch, being 1672 times that of water, it is plain that if S represent the number of cubic feet of water vaporized per minute in the boiler, and if a represent the area of the cylinder expressed in square feet, $1672\ S$ will be the volume of the steam generated per minute, whence results that $\frac{1672\ S}{a}$ will be the velocity, in feet per minute, assumed by the piston of the engine working at that pressure. Moreover, the *effective* pressure of the steam or the load which the piston can support, is $16 - 4 = 12$ lb. per square inch; which gives $12 \times 144\ a$ for the total resistance, in pounds, supported by the piston. Thus, in the condensing engine, the effect produced by the number S of cubic feet of water, expressed in pounds raised one foot per minute, is $1672 \times 12 \times 144\ S = 2{,}889{,}216\ S$. Calculating in the same manner the case of the locomotive engine, we find that the effect it produces for the same vaporization S, working at the total pressure of 75 lb. per square inch, or at the effective pressure of 60 lb. per square inch, and expressed in pounds raised 1 foot per minute, is $381 \times 60 \times 144\ S = 3{,}291{,}840\ S$. Therefore, finally, its useful effect, per cubic foot of water vaporized, will exceed that of the condensing engine, and this again is a circumstance, examples of which will be found in the *Theory of the Steam Engine*.

Thus this new peremptory condition which the experiments ought to satisfy is as unfounded as the former ones; and, in fact, Mr. Parkes contradicts it, himself, a little further on (pages 157, 158), so that we might have referred his first argument to his second, for refutation. But, besides the foregoing observations it must be borne in mind that the velocities employed by Mr. Parkes, for locomotive engines, being nearly all considerably augmented, as has been explained above, he must necessarily arrive (pages 85, 87, 89, 92, and tables x., xiii., xiv., xvi.), at exaggerated results, for the effects which he supposes to have been produced by those engines; and therefore his comparison between locomotive and stationary engines, is altogether founded upon false calculations.

It is remarkable, finally, that in applying the preceding considerations to all the experiments published on locomotive engines, by different engineers, namely, Messrs. R. Stephenson, N. Wood, E. Woods, and Dr. Lardner (pages 102, 117, 118, 159), Mr. Parkes finds that the conditions to which he proposes to subject those experiments are not verified in them. Such a result ought to have put him on his guard against the validity of his own arguments; but the want of knowledge in the principles of Mechanics and of habit in mathematical reasoning (the author tells us that he is more accustomed to handle the hammer than the pen), causes him to heap errors on errors, combining and complicating them unawares, till he arrives at a point where he does not produce a single result that is not erroneous.

There is a matter of surprise in the numberless errors contained in the paper of Mr. Parkes, and of which, for the sake of brevity, we have noticed merely the principal ones, reserving the rest for another opportunity if necessary. But on inquiring what was the end he had proposed to himself, what was to be definitive consequence of his labour, one is yet much more surprised.

His object is to propose a new measure of the effect of locomotive engines; and this *new* measure is what he calls the "momentum" generated, that is to say, "the product of the mass, in tons, of the engines, tender and train, multiplied into its velocity, in feet per second." This standard is to "represent the repective mechanical effect produced per second by each engine" (page 128).

Now, the true mechanical produce includes the whole of the resistances and frictions really overcome by the engines; that is to say, the friction of the carriages, the friction of the engines, the gravity of the mass on the different inclines traversed, the atmospheric pressure, the pressure due to the blast-pipe, the resistance of the air, &c.; and in multiplying the sum of all these resistances, by the velocity of the motion, we shall have the mechanical effect produced. But, if among all those divers resistances, we take account *only* of the friction of the carriage, and the engine, omitting all the rest, and if we suppose, for an instant, that friction to be 6 lb. per ton, as well for the engine as for any other carriage, we shall have the effect produced, in multiplying the weight of the train, tender and engine included, first by 6 lb., and afterwards by the velocity of the motion. Now, it is evident that in calculating thus, we shall have exactly the same number given by the computation of Mr. Parkes, excepting that all of them shall be multiplied by 6. Therefore, the new measure proposed comes merely to this, that the effect of the engines will be calculated by the friction of the carriages only, and that of the engine considered as a mere wagon, and the results divided by 6.

But, as this pretended "standard" comprehends only a portion of the resistances really overcome; as it does not include the gravity of the train, which may, according to circumstances, offer a resistance exceedingly great, or null, or even act in favour of the motion; as it does not include the counter-pressure due to the blast-pipe, which varies according to the velocity, the rate of vaporization and the size of blast-pipe; as it does not include the total friction of the engine, but only the friction of its wheels, as a single wagon; as, above all, it does not include the resistance of the air, which, from experiments of which Mr. Parkes is "utterly ignorant" (page 124), varies according to the bulk of the train and the square of the velocity, so that the quantity neglected, on that account, in the calculation may, at times, be quite trifling, and at other times, exceed the *momentum* of Mr. Parkes itself; as in fact this pretended *new* measure is nothing more or less than the common *useful effect* of the engine, as given in many works and particularly in our *Theory of the Steam Engine*, and *Treatise on Locomotive Engines*, with these differences only that in Mr. Parkes's calculation, it includes also the weight of the engine, and that it is erroneously computed, inasmuch as, in multiplying the weight of the train, in tons, by the velocity, the calculation is made as if the whole weight were raised up in the air by the engines, instead of being dragged or rolled along the rails; as, finally, this pretended standard, instead of being constant, varies with the velocity, just as well as what Mr. Parkes calls the *commercial* and *useful* effects, so that it is not more easy to know the one than the others, or that the rule of Mr. Parkes, which we are going to quote, refers to the one just as well as to the others; for all those reasons, then, we see that the aforesaid measure is not new, that it does not measure the mechanical effects of the engines, and finally that it is nothing more or less than the common useful effect (weight of engine included), calculated in considering the whole train raised up in the air and the engine as a mere wagon.

After having thus found upon *reasoning* the accuracy of his new measure of the mechanical effect of the engines, Mr. Parkes proceeds to show the "powers of this method of analysis" (page 131). Collecting all the erroneous results which he has obtained in his tables, and admitting then, as accurate, the experiments of the *Treatise on Locomotive Engines*, which he thought of demonstrating false before, Mr. Parkes forms a table in which he sets in view, on one side, the vaporization effected by the engine, and on the other side the useful effect produced, giving it only the name of *momentum* when it includes the weight of the engine besides that of the wagons. Then comparing the vaporization to the effect produced, and taking an average, not upon his own experiments, *since he has made none*, but upon all the experiments which he has collected from the divers works published on the subject, he presents (page 130), as the result of his labours, the following conclusion, which he proposes to substitute in place of every other kind of research on locomotive engines.

When the velocity of a locomotive engine is augmented in the proportion of 1·52 to 1, the vaporization necessary to produce the same effects varies in the following proportions:

To produce an equal *momentum* (an equal useful effect, weight of wagons and engine included), in the proportion of 1·42 to 1, or in a proportion something less than that of the velocities; to produce an equal *commercial* gross effect (an equal useful effect, including the weight of the wagons), in the proportion of 2·43 to 1, or nearly as the square of the velocities; to produce the same *useful* effect (the same useful effect, net weight), in the proportion of 3·41 to 1, or nearly as the cubes of the velocities.

This is the definitive result which Mr. Parkes has attained, and the help of which seems to him to render it needless henceforward to seek to determine either the friction of the wagons, or that of the engines, or the resistance of the air, or any thing in fact that may influence the effects produced; researches which appear to him to offer insurmountable difficulties. Possessed of the *wholesale* result of Mr. Parkes, nothing more will be needed. Does any one wish, for instance, to know what load a given engine will draw at 25 miles per hour, on a given inclination? to know what velocity it will assume with a load of 60 tons? to know what is the maximum of useful effect that it is capable of producing? to know what proportions must be given to it, in order to obtain desired effects? Why, having recourse to Mr. Parkes's result, the solution of all these questions is self-evident!

It is evident, on the contrary, that Mr. Parkes's result, even were it exact instead of being founded on erroneous calculation, could lead to but one thing, namely, to find the useful effect produced by an engine at the velocity of 30 miles per hour, when the same effect, in quite similar circumstances, is known at the velocity of 20 miles. But, even then, making use of so rough an approximation, in which all is thrown in the lump: friction of the wagons, friction of the engine, resistance of the air, resistance owing to the blast-pipe, &c., the result could never be depended on. Assuredly, calculations like these do not tend to the progress of science; they would rather lead it back to its first rudiments. For this reason we persist in our belief that the only means of calculating locomotive engines, is to endeavour to determine, as exactly as possible, each of the resistances which oppose their motion, and by taking an account of the value of those forces in the calculation, we may then in every case attain a valuation really founded in principle, of the effects of every kind that are to be expected from them.

MR. RANKIN'S WOOD PAVEMENT.

(Abridged from the Polytechnic Journal.)

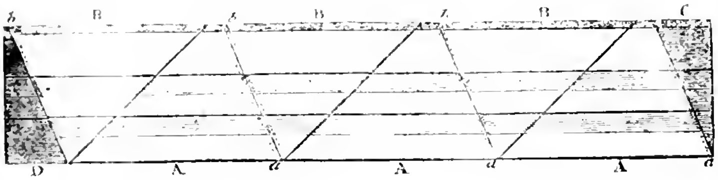
This new wood pavement is the invention of Mr. Rankin, and manufactured by Messrs. Esdailes and Margrave at their City saw-mills. We will first proceed to describe the process of its manufacture from the beginning. A square-sided piece of timber, of a proper length, is provided, each side being four inches across. By the application of the steam machinery at the saw-mills, two equilateral *grooves* are rapidly cut along the whole length of the piece. As soon as this operation is performed, the piece is turned completely over, and on the side immediately opposite to that previously grooved, two *tongues* are cut, in like manner, along its whole length.

The length of timber, thus prepared, will have two sides opposite to each other with plain surfaces, one of the remaining sides *grooved*, and the other *tongued*: and in this state it is ready to to be cut into blocks, to be laid down as street pavement.

Simple as this grooving and tonguing may appear to be, they constitute, in fact, a principal part of the merit of the invention. The fundamental principles of geometry have been strictly attended to in their construction, and the result is consonant with an adherence to scientific laws. The tongues of one piece of timber fit into the grooves of another: and when two pieces are thus united, the are not *flush* with each other, but the side of the second piece projects beyond the side of the first to which it is fastened, exactly half its own width. If a third length were attached to the second, in the same way that the second was to the first, the edge of this third length would again project beyond that of the second, half its width, and the same effect would be produced with any number of pieces.

The lengths, first prepared in the way described, will then have to be cut into blocks. In order to facilitate information on this part of the plan, we here introduce a diagram.

Fig. 1.



It will be observed there are two shaded parts, C and D, one at each end of the length. These are cut to waste: but the amount of loss is so small as hardly to be worth consideration in any estimate of prime cost. With this trifling exception, the whole of each piece, no matter how long it may be, is brought into use. The dotted lines, which intersect the length, indicate the direction of the saw when it is converted into blocks. A A A are base-blocks, and B B B the key-blocks. Let us, for the sake of an example, suppose that one length is cut into six blocks. Of these, three are intended to be laid upon the ground with their bases downward, and the other three to form the surface of the pavement by reversing this position, and placing their bases upward; and this is the only distinction between the blocks of which Mr. Rankin's pavement is composed. The lower blocks are called base-blocks, and these support the others; the upper blocks are called key-blocks, and these firmly interlock the under blocks and themselves together. The annexed drawing, fig. 2, represents the *grooved* side of a base-block, *a* and *b* being the grooves: and the engraving opposite fig. 3, presents the *tongued* side of the same base-block, *a* and B A being the tongues. The two similar sides of the key-block are also exhibited in the accompanying diagrams; *a* and *b* in fig. 4, representing the grooves, and *a* in fig. 5 the *tongue*. Such is the shape of the blocks of this most ingenious pavement; and begging our readers to bear in mind that there are but two sets, upper and lower, and that the individual parts of every block of each set are geometrically alike, we proceed to the proof of its advantages, with the promise of which we started.

Fig. 2.

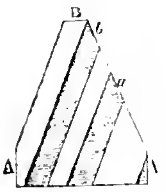


Fig. 3.

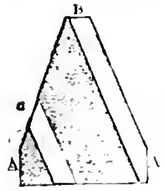


Fig. 4.

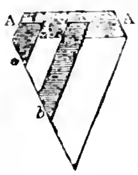
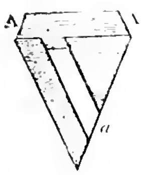
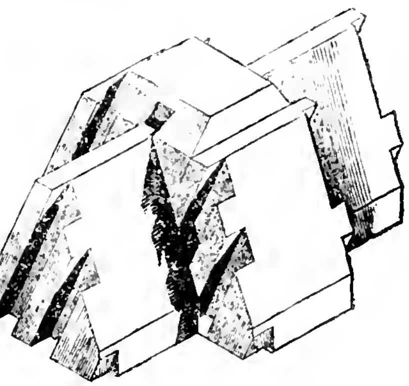


Fig. 5.



As "UNCHANGEABLENESS OF POSITION" is a primary and most important quality of this pavement, we will first explain how this is secured. Fig. 6 is a representation of five blocks locked together. It will be noted that four of these are base-blocks, and but one a surface block. If examined in detail, it will also be found that the key or surface block is supported by the others, and by all equally; and that no surface pressure can separate them laterally, or drive them asunder; so that any weight applied at the surface, is distributed over a base nearly four times its area; but these four base-blocks likewise respectively lock in with four other different series of the same kind, and so on continuously from side to side of the street, where they rest on the kerbs, and longitudinally from end to end of the pavement; and thus

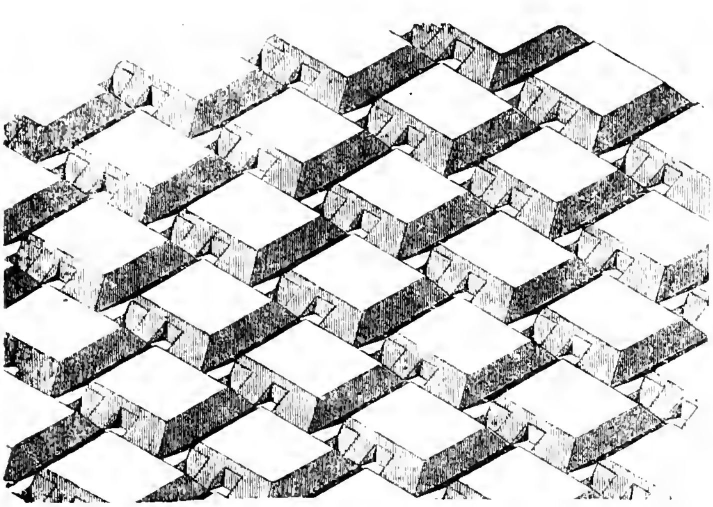
Fig. 6.



the weight applied to an individual surface block is not confined to the four base-blocks, its immediate supporters, but is transmitted throughout the whole structure, and no one part can yield to the superincumbent pressure, without causing a general deflection from kerb to kerb; and as this is manifestly impossible, except to a small amount, it must be granted, that the base of the pavement can never be affected, or dislocated, by any traffic whatsoever: no inequality of surface, from the sinking or depression of individual blocks, can consequently arise, until the surface blocks themselves are fairly worn out, a result which is assuredly much more remote in wood than the public are yet prepared to believe. The construction of this pavement, therefore, as regards uniform stability of base, places it beyond all comparison with any stone paving now in use, because it includes the principle of the arch, the kerbs representing the abutting piers, and the upper or surface blocks the key-stones: and the greater the weight, the more solid does the structure become by the tightening process of the wedge-shaped key-blocks, with their grooves and tongues. If our readers will again examine figures 1 and 2, they will observe that the angular terminations on two opposite sides of the base of every substratum block (A A) are chamfered or squared; and if, furthermore, they will suppose a row of these blocks to be placed on the ground between two piers, or abutments, with their chamfered edges together, and the upper blocks afterwards introduced in their proper place, it will at once be evident that no sinking can take place without complete destruction of the parts. In truth, by this arrangement of shape, unchangeableness of position is absolutely obtained.

But, after all, the most important consideration in the adoption of wood as a substitute for stone in the street-paving of the Metropolis, will ever be the providing an effectual REMEDY AGAINST SLIPPERINESS. No pavement of wood, that does not offer a firm foothold for the horse in all states of weather, will ever become generally adopted in London. In every situation, whether in continuous motion, in backing, in being abruptly pulled up or suddenly started, the horse must be able to maintain his feet in precisely the same place in which he places them down, otherwise wood pavement will not have realised the grand advantage of which it is susceptible. That nothing of the kind has been hitherto accomplished, needs but a five minutes' examination of any public street paved with wood immediately after and during the existence of a passing shower. The plunging and sliding about of the animals are then awful. If an omnibus going at the usual speed were suddenly required to be stopped to take up a passenger, its momentum would force the horses along the pavement several yards, in spite of all their efforts to prevent it. In starting too, their feet rapidly slip from under them for several moments before they can succeed in moving the vehicle. Frequently they fall down and are injured, and the greatest precautions are necessary under such circumstances to prevent accidents. These things happen because there is no foothold for the horse in damp weather upon any of the wood pavements hitherto introduced. We can testify, of our own knowledge, that the reverse of this is the fact in the case of Mr. Rankin's pavement. Indeed, it speaks for itself; no argument is required to prove that the foot of a horse cannot slip over its surface. At the same time it offers no resistance to the uninterrupted progress of the wheel, and therefore a remedy against slipperiness is not obtained by any sacrifice of facility of traction. A general character of the paving may be gleaned from the annexed engraving.

Fig. 7.



Here, then, as the licencees fairly remark, is a pavement, removing at once the great and hitherto insurmountable evil attending the use of wood, the insecurity of the horse's foothold: and offering a facility of removal equal to the present stone paving, and an evenness of surface, and combination of construction, together with an absence of noise and increase of cleanliness, which wood alone can give.

We have felt great pleasure in thus calling the attention of the public to the invention of Mr. Rankin, because we know it to be very ingenious, and believe it to be, for all seasons, by far the best wood pavement hitherto made public. The government ought to allow an experiment upon an extended scale to be made with it duty free, for the question of wood pavement is one of metropolitan, if not of national, convenience.

PROFESSOR FREUND, DANISH SCULPTOR.

If not in the fine arts generally, the north of Europe has distinguished itself in sculpture—that one of them, on which the fame of Greece now chiefly rests, and which more especially demands a critical study of beautiful forms and proportions. The eminent and excellent sculptors Sweden and Denmark—and we may add Russia—have given birth to, sufficiently vindicate their pretensions and character in that branch of art. The names of Martos (+1835) and Boris Orlovsky (+1837), of Sergell, Bystrom, and Fogelberg (belonging to Russia and Sweden), may be said to be European ones, while that of the great Danish master almost dims that of Canova himself. Neither is it of her Thorwaldsen alone that Denmark has cause to be proud, since she can boast of having given to the world another highly gifted sculptor in Hermann Freund, who died at Copenhagen in July 1840.

Of this last-mentioned artist we are not as yet prepared to give any biographical sketch, nor even to enumerate his principal works. We are enabled, however, to state a few particulars relative to some of his subjects from ancient northern mythology, which had been a favourite study with him, and of whose imagery and traditions he sought to avail himself for plastic and sculpture, in like manner as his countryman Oehlenschläger has done for poetry and the drama. It was here that he displayed poetical conception, a noble simplicity, a characteristic yet graceful severity, free from aught like mannerism, and from those mere conventionalities upon which so much stress seems to have been laid by most modern sculptors, to the exclusion of either originality or feeling. Among the works of the class above referred to, is a bas-relief representing the three Nornas or northern Fates, who are consulted by Mimer, Baldur, and the Valkyrias, in consequence of Iduna, the goddess of youth, having been carried off by the evil spirit Loke, and thereby both gods and mortals subjected to the infirmities of age and decay. In this dilemma Baldur, the Apollo of the Scandinavians, solicits the counsel of Mimer, the god of wisdom, and he, being unable to assist by his advice, they both proceed to solicit that of the Nornas. These last form the centre group in the composition, and represent Veranda, she who presides over the *present*, Ur, who presides over the *past*, and is here seen recording its events upon a tablet; and Skulda, or the *future*, with her finger upon her lips. To the right of these figures are those of Mimer and Baldur, the former with a long beard and arrayed in a bear's skin, the other a beautiful youth, vying in form with his classical prototype. To the left of the centre group are the three Valkyrias (whose office it was to tend upon the souls of the blest in Valhalla, the Scandinavian Elysium), who are here represented as attired in long under garments, and with wings growing from their temples.

Among Freund's single figures and statues are many representing personages belonging to the same mythological system: viz. Odin, Thor, Freya, Iduna, Bragur & Loke. The first-mentioned of these is seated on a throne, and wears a diadem inscribed with Runic characters. He is the Scandinavian Zeus, and like the Grecian one, is distinguished by majesty of appearance, but his features are more aged, his form less expressive of strength: for though superior in power to the rest of the deities, Odin was supposed to be himself under the control of Fate—an arbiter more awful and tremendous than even the sovereign of the gods. His attributes are two ravens, seated on the arms of the throne, which were the messengers commissioned to bear his orders to gods and mortals—and two wolves couched at his feet.

Thor or the Thunder-god, is a standing figure, with his right foot advanced forwards, and looking earnestly on one side. He is here supposed to have just hurled forth his lightning, and to be striking a thunder-peal with his hammer. This figure—which is somewhat between that of a Jupiter and a Hercules—is quite naked with the exception of a wolf's skin, hanging upon one arm, and reaching to the ground. Beside him is a coat of mail, which serves to support and balance the statue. In a second figure he is somewhat differently represented—in a more composed attitude, with his hammer in his right, resting upon his armour, and a thunderbolt in his left.

In the group of Freya, the goddess fabled to preside over sexual passion, that figure is represented veiled, resting her chin on her right hand, and holding a wreath of flowers. On one side of her is Siofne (under whom was typified the first emotion of love), endeavouring to draw aside her veil and behold her countenance; while on the other is Hnos, or Enjoyment, with her left arm around her mother Freya's neck. Both Siofne and Hnos are naked figures. So far the allegory seems well conceived, but there is one circumstance which, though it may be significant enough as a symbol, is far more associated with the ludicrous, than with either the sentimental or poetical, according to modern ideas; for instead of turtle-doves, the northern Venus has at her feet—two cats! as images of the potent influence of *la belle passion!*

Iduna, the Scandinavian Hebe, is represented by a graceful youthful figure, holding in her left hand a patera filled with apples, and in her right a cup of mead. Her luxuriant tresses fall from beneath a long pointed cap, similar to that still worn by the maidens of Iceland, which hangs down behind, where it terminates in a tassel.

Bragur, her consort, and the Scandinavian deity of poetry and minstrelsy, and whose office it is to recreate the indwellers of Valhalla with his songs, is shown in the act of playing upon his harp, which is attached to a riband that crosses his shoulders.

The evil malicious spirit, Loke, is characteristically described—under a shape speakingly expressive of the disposition attributed to him. There is something stealthy in his very attitude, as he creeps along resting his chin upon his left hand, while brooding upon mischief. His other claw-shaped hand is partly concealed beneath his mantle, as are likewise his long and ugly ears, and his bat-wings.

However admirable may be the talent manifested in those productions, it is with us a question whether it might not have been more advantageously employed. If heathen mythology is now worn out, if it does not address itself to our sympathies, especially when served up—as it necessarily must be in modern sculpture, at second-hand; that of Scandinavia has to contend with the additional disadvantage of being less known, consequently less intelligible. All attempts to revive it, to bring it again into vogue, either in poetry or the graphic and plastic arts have proved comparative failures. Did the fame of Gray rest chiefly upon his productions of that class, it would be much less than what it actually is; or rather, he would share the fate of Sayers, whose northern poetry has been descanted upon and praised by critics, to be forgotten—supposing it ever to have been regarded—by the public.

A new Paving.—M. Polonceau, the engineer of Paris, proposes a new mode of paving for Paris, consisting of artificial stones made of clay, sand, and pulverized charcoal. This mixture stood heat well, and became vitrified; it also dried without cracking. The stones were made in an hexagonal form, and could be put down or taken up one by one. Government had given leave for an experiment to be made of this system in one of the streets of the capital.

COMPETITION DESIGNS.

(Benevolent Institution for the Relief of Aged and Infirm Journeyman Tailors.)

The mal-administration of competitions for designs becoming every day more apparent, the indignities and imposition practised upon architects who are foolish enough to yield to importunity and submit the result of their labours to the decision of men not merely unfitted for the task, but in most cases *prepared* to decide in a certain manner even before the reception of the drawings, becoming additionally glaring, it surely only needs that some few more home-cases should be brought forcibly before the public eye to induce the entire abandonment of the present scandalous system, and to enforce from committees an honest decision and something like consideration for the time and talents of the professional men applied to. With this view we proceed to lay before our readers the particulars of a recent competition which have come to our knowledge in the hope that the statement may aid in rousing public indignation against such proceedings: furthermore, we have a latent hope that by putting the whole matter fairly before the parties interested they may be led, as it is not yet too late, to retrace their steps.

Some few months ago the Committee of the Institution named at the head of this article, requiring designs for an asylum which they propose to erect in the Hampstead Road, invited a limited number of architects to forward drawings, namely Messrs. Lee and Duesbury, Mr. Jones, Mr. Vulliamy, Mr. Thomas Meyer, Messrs. Winterbottom and Sands, Mr. George Godwin, and Mr. E. H. Browne.

It being understood that one of the competitors, namely Mr. Meyer, was brother of a member of the Committee and had already sent in a design, some of the other architects inquired pointedly whether or not this gentleman was to be in any degree considered more than the rest, and were informed by various members of the committee that the best design would positively be accepted whether made by Mr. A. or Mr. B. Designs were accordingly sent in by all the gentlemen we have named. A building committee was appointed by the general committee to examine the drawings, and recommend for adoption that which they considered the best. They accordingly met various times, gave a long consideration to the matter, and ultimately selected Mr. Godwin's design as the fittest for their purpose; a written report to this effect was drawn up and the matter was talked of out of doors as a thing settled. Several weeks having elapsed after this had reached Mr. Godwin's ears accidentally, without his receiving any special communication, he applied to know how the competition had terminated, and the following letter was shortly afterwards sent to him:

Benevolent Institution, &c.
32, Sackville Street,
14th July, 1841.

SIR—I beg leave to inform you that, by a decision of the Board of Directors, their choice of an architect has fallen on Mr. Meyer.

I am, Sir,
Your obedient servant,
George Godwin, Jun., Esq. T. P. DAVIDSON, Sec.

The gentleman to whom this was addressed accordingly called the next day to fetch away his drawings, and being shown into the room of meeting, saw there five of the seven sets of designs, including those selected as the best. In consequence of this examination he immediately addressed a letter to the Board, which, as it puts the whole matter in the fairest point of view possible we here annex

To the President and Directors of the Institution for the relief of infirm Journeyman Tailors.

Brompton, July 17, 1841.

GENTLEMEN—I have the honour to acknowledge a note from your Secretary, stating "that the choice of an architect has fallen on Mr. Meyer."

Some time previously I was told, in three different quarters, that *my* plans had been selected by the Committee as the most approved, and I felt, therefore, a little disappointed on receiving official intimation to the contrary; still, considering that I must have been misinformed, I was of course quite disposed to bow to the decision in silence, and to believe that a better plan than my own had been chosen.

Applying, however, a few days back in Sackville Street to regain the drawings, I there saw the various designs of the other competitors. Amongst them were those of the preferred candidate, and an examination of these led me to the conviction, that such a decision had not been come to as those architects who had given their time and attention to the subject at the request of the Board, had every right to expect. I make this remark with the greatest deference to every member of the Board, for many of whom personally I have great respect.

Far be it from me to deny that the Board had right to appoint any architect they pleased: what I would very deferentially submit is, that having induced six or seven architects to make plans for the proposed asylum, at an expense of both time and money, in the full persuasion that the author of the best design would be appointed to execute the building, the Board were bound to make that selection solely on the ground of *superiority*, and without reference to the name of the author of the plan.

That such has not been the case, referring solely to the designs submitted, and without the slightest intention of disparaging Mr. Meyer's fitness for the task, I venture without hesitation to assert.

Apart from private grounds (and even in this respect, as my plan was selected by the Building Committee after due consideration, as the best adapted to your purpose, I am, perhaps, authorized to address you,) I am induced to this step by strong public motives—by that desire to obtain a just administration of competitions for designs which is felt at this time by all those who wish the prosperity of the arts in England.

On this ground then, gentlemen, I appeal to your sense of justice, and the desire which, I will venture to believe, you all have to maintain the good opinion of the world, to give this matter re-consideration.

I hope sincerely that you will not deem any thing I have said disrespectful in the slightest degree, and that you will permit me to subscribe myself, gentlemen,

(Waiting your decision),
Your humble servant,
GEO. GODWIN, Jun., Architect.

The result of this letter was that the Board, at their next meeting, refused to confirm the appointment of Mr. Meyer, and it was proposed that the whole of the designs should be referred back to the decision of one or more architects. A subsequent meeting, however, influenced in a manner one would hardly venture to hint at, overturned this intention and confirmed the original appointment. Here the matter stands. We have seen the various plans, and without stopping to inquire whether Mr. Godwin's plan is the best (a point we don't in the least care for), we have no hesitation in saying that not merely is the selected design *not* the best, but that it is perhaps the least entitled of any one of the seven to claim for its author the appointment. If the Board desired to employ Mr. Meyer, why did they not do so in the first instance? No one would have questioned his fitness, or their right to appoint. But having given seven gentlemen the trouble, and led them into the expence, by special invitation, of preparing designs, we assert that the Board were bound, by every feeling of honesty, to appoint the author of the best plan, without the slightest reference to his name or his connexion with the society. We hope even now it is not too late for redress.

COMPETITION.

SIR—If your readers will refer to the Athenæum for the last month, they will find an account of a highly entertaining squabble arising out of the competition for a new church in the parish of Paddington.

When this competition was announced, I applied for the particulars, and subsequently for further information on a few points which did not appear to my humble comprehension to be quite explained in the instructions. Without troubling you with the whole list, I will mention one question, viz. How many of the prescribed sittings were to be in pews, and how many in free seats? to which I took the liberty to add the further inquiries, whether any member of the vestry would be permitted to compete, and to whose judgment the designs were to be submitted. To which answer was made, to the first question, that many architects had applied for the like information, but that the instructions already given were considered sufficient—to the second, that no member of the vestry *could* have an interest in any parish work—and to the third, that it was calculated to give great offence! and that it was quite enough for the architect to know that the parties concerned were "all honourable men."

Of course all applicants were obliged to be content with the same answers, for, *of course*, nobody gave, or profited by, private information—nobody ever does. I submit, therefore, that any one who competed after receiving such answers, got what he deserved, whatever he may have or may think he has to complain of, and I trust that none of the profession who lend themselves to the system of scrambling for jobs in the dark, will ever be better treated.

I am, Sir,
26th August. Your obedient servant,
T. J.

ON RAILWAY CARRIAGE WHEELS.

SIR—In your number for June last, there is a paper, page 197, professing to contain accounts of improvements in Railway Carriage Wheels.

The writer's first two heads of method contain two different modes of constructing the axle of a pair of wheels, to allow these to turn independently. One would infer from his manner of stating the modes, that they should be united in one pair. They evidently cannot. At all events, he implies that, on either plan, the independent rolling of the wheels, together, I suppose, with the additional flanges, would entirely prevent the engines being thrown off the line by an obstacle. Now the *independence* of their rates of motion cannot facilitate the prevention of such an accident.

In his third head he tells us that his wheels should be of cast iron, preferably to malleable iron. But why this preference? It is universally agreed that malleable iron is superior to cast iron for all wheels of the kind now in use. Why are the writer's wheels to be an exception? Is it on account of spreading? The writer himself says that malleable iron wheels spread out only on the bare side. And, therefore, now that they are to be flanged on both sides, the spread will be checked, therefore let us yet use malleable iron. There is no other new circumstance requiring this change of metal. The jolts, strains, and every thing else will be the same. Again, therefore, let us yet use malleable iron. His preference for cast iron is of a kind with the dislike of Dr. Pell versified in the immortal quartet so often quoted. Again, he says that the wheels as they are double flanged will not require to be so strong as at present, because side jolts will be divided between the opposite wheels. The consummation of lateral strains and jolts would be both wheels rising on the rails, which case, therefore, we must consider in judging of the required strength. Admitting the writer's assumption that both wheels share the strain equally, (which however cannot always be, as in cases of variation of gauge, which fact itself is an argument against his conclusion), it is clear, as Telford has it, that the engine on being raised, is elevated on both rails through the depth of flanges, and that therefore its centre of gravity also rises through the mean depth of flanges. Now with the single-flange wheels the engine would be raised only on one side, through the depth of flange, and therefore its centre of gravity rises through only one half this depth. It is clear again, then, that double flanged wheels would have as tight work each as the single flange wheel, and therefore *would* require to be as strong. What right has he to deny this, who never proved the contrary? He again says that the face of the wheels ought to be in outline a circular segment instead of conical. Now the face of a wheel, as he views it, is not conical; it is a straight line inclined to the axis. He proceeds to mention by wholesale the great saving in his plan. Particularly, he says, no attention will be required in laying the rails to an angle in straight parts. What although, there will be the same attention altogether in laying them horizontally? At all events, he allows that the angular position is required at curves. But under the fifth head, he says that railways are all curves together; therefore he must conclude against himself that the saving in straight parts is just nothing, since he supposes there to be no straight parts at all.

Again, he says that the inclination of the rails the same way on curves instead of towards each other, as now set, will enable gravity to act more forcibly. This can be only on the ground that the comparative virtual velocity in the direction of gravity is greater in the first case than in the other. The writer has evidently not troubled himself as to the truth of this gratuitous statement. It would be easy to prove that the centre of gravity moves through equal depths for the same horizontal movement, in both cases. And therefore is he entirely wrong.

Again, he says that the inclination of the rails to one another in present plans causes great friction on the journals. How so? The pressure on the journals must be the same. Nor is there any twisting or other adverse action of the kind. In fact, the only sources of friction by this cause would be at the contact of wheels and rails, owing to the wedge-like action of the conical wheels, which is utterly insignificant. Again, each wheel cannot possibly press the other against the rail, for their action is equal and opposite, and therefore nothing.

In his fourth head he has asserted all, proved nothing. How did he know the exact saving of power he mentions? It is evident that his improvement was never in operation. What right had he then, when he knows nothing about it, to pronounce so decisively as he has done, and that not only in this paragraph, but throughout the whole paper.

His last notable and most ridiculous statement is set down in the fifth head. He tells us that railway curves do all differ in intensity, and they must therefore be of various radii. But this evidently requires wheels of various diameters to suit them, and to produce that sweetly-gliding motion which he loves. This exigence is beautifully provided for in conical wheels. Now he proposes to set his engine running upon the flanges of the wheels forsooth when they enter upon curves. By this exceedingly quick plan, the wheels are evidently adapted to only one kind of curve, and would therefore, on any other curve, grub up the rails most sweetly indeed.

I am, your's, respectfully,

D. C.

Glasgow, July 9, 1841.

QUESTIONS FOR THE OPINION OF THE EDITOR.

Sir—I shall feel obliged if you will inform me if I could sustain a charge in a court of law under the following circumstances. In the early part of the year I was applied to, amongst other tradesmen in the parish, to tender for certain alterations and additions required to a building, in the erection of schools, and in due course I was informed that my tender was accepted, and that a delay of a week would most likely take place, but from that time to this, a period of six months and upwards, I heard nothing of the matter until a day or two since, when I received a letter (certainly a polite letter), stating circumstances prevented the design from being carried into effect, and that they were sorry I could not have an opportunity of carrying my contract into effect.

Do you not think, Sir, I should be fully justified in charging two per cent on the amount of my tender, as some judgment was necessary and much time taken up in making the estimate.

I am, Sir,
Your obedient servant,
Aug. 9. T. O. M.

In all cases when our opinion is required, we should be furnished with full particulars; for instance, in the above case, a copy of the advertisement should have been forwarded. Taking for granted that there is nothing very special in the wording of the advertisement, and that there was nothing personally objectionable to the tradesman making the tender as to his general way of doing business in point of construction, or for want of pecuniary means to fulfil his contract, we are then of opinion that a claim could be legally substantiated against the parties advertising.

We have some recollection of a case being tried about six months since, either in the Sheriffs' or Secondaries' Court in London, of a builder suing a person for the trifling sum of about 3*l*. for his loss of time in making an estimate of some works; after receiving the tender, the defendant declined employing the plaintiff, without showing any reasonable excuse; in this case the plaintiff recovered the sum sued for. Our impression is that there are other cases which might be cited; probably, before our next number appears, some of our readers will be able to furnish us with some information regarding this question, which is one of very great importance, not only to the builder, but also to the profession.—Editor.

Sir—I thank you for your reply respecting the legal arrangement of chimney flues, and from which I gather that the termination at top, if of different materials from the stack, may be of any size that one pleases; but suppose I choose to have nothing resembling a chimney-pot, is it your opinion that the law will forbid such a contraction for the last two or three feet of the brick or stone, as is now effected by the addition of the cement or pottery abominations?

I am, Sir,
Aug. 10. Your obedient servant,
A subscriber.

If the chimney be built as our correspondent suggests, it will be necessary, in our opinion, to construct it with an aperture not less than 14 in. by 9 or 12 inches diameter, agreeably to the Act. We hope that the legislature will see the necessity for altering the clause in the act before it comes into operation; the Architects' Institute or Society should interfere and obtain a repeal or modification of the objectionable clause before the act comes into operation.—Editor.

Sir—I have lately had an opportunity of seeing the Illustrations of Ancient Halls by Nash. Now it struck me at the time, that though they were certainly very pleasing to the eye, how much more *useful*, simple but correct outline elevations and plans would have been to the architect and others, as it would be the means not only of preserving a true delineation of the subject, but would also be the means of furnishing numerous data in erecting similar edifices, which I know to be useful to all. Now as many very beautiful specimens still exist in this part of the country, I have it in contemplation to bring out a work of this kind. The only question is, whether architects will patronize it as they ought to do, as I am sure plans, elevations, &c., of such buildings must be very acceptable to them. If you will be kind enough to give your opinion in your next number, I shall feel greatly obliged.

A Subscriber.

Such a work as our correspondent describes has already been commenced, but not proceeded with. We think a work got up at a moderate price, suitable for the architect, might stand a chance of meeting with support, but we are afraid to recommend the publishing of it, as it is very doubtful if our correspondent would be remunerated for his labour.—EDITOR.

MOVEABLE FURNACE BARS.

SIR—With your permission I beg to make the following remark respecting an article which appeared in your valuable Journal of last July, under the head of "New Inventions and Improvements." The article in question is one which I suppose to be an extract from the specification of Mr. C. W. Williams's patent improvements in furnaces and boilers.

If there be any credit due to the discovery of the method therein described, for producing the continual up-and-down movements in the grate bars, that credit is most certainly due to the late Mr. Mathew Murray of Leeds, who had the furnace of an eight horse steam engine, so constructed as to keep the grate bars continually in motion, by means of small eccentrics formed on a horizontal shaft, which revolved beneath, and supported the ends of the grate bars next to the furnace bars. This was done with an intention to prevent the formation of clinkers, and to keep the fire perfectly clear; but, as the plan did not prove perfectly satisfactory to the inventors, the whole system was very shortly taken out, and replaced by that then most commonly adopted. It appears to me somewhat singular that this contrivance, though upwards of fourteen years old, should at length become the leading feature in a specification of patented improvements.

I am, Sir, with great respect,
Your humble servant,
FLORENTINE.

Holbeck, August 16, 1841.

REVIEWS.

A Series of Original Designs for Churches and Chapels in the Anglo-Norman, Early English, Decorated English, and Perpendicular Styles of Ecclesiastical Architecture, including also designs for Rectory Houses and Schools in the Domestic English and Tudor Styles. By FREDERICK J. FRANCIS, Architect. London: John Weale, 1841.

This forms the first part of a series of original designs, which are divided into four classes. 1. The Norman. 2. The Early English. 3. The Decorated English, and 4, the Perpendicular English. We do not think however from the specimens before us that Mr. Francis is so happy with his pencil as with his pen, neither are we of opinion that these designs are likely to induce the Church Building Commissioners to abandon their "Barn Church Architecture." We might instance several defects, for instance in design No. 1, we have the principal entrance opening direct into the body of the Church without any lobby, or second entrance; the same again in the side entrance of No. 2, nor do we admire the stunted steeples which have been introduced in designs Nos. 2 and 6, the pedimental parapet of No. 7. and the stepped parapet of No. 12 design, nor the square hood moulding over the pointed windows of the clere-story.

Description of a Series of Geological Models. By T. SOPWITH, M. Inst. C.E., F.R.S., &c. Newcastle: Blackwell.

☞ As a Mineral Surveyor Mr. Sopwith has had excellent opportunities of acquiring practical geological information, and he has been no less successful in imparting it to the public. The models, which this work is intended to describe, illustrate the nature of stratification, valleys of denudation, succession of seams in the Newcastle Coal Field, the effects produced by faults or dislocations of the strata, intersection of mineral veins, &c. These models are very ingenious and useful, and the work before us besides being a necessary companion to them, is of great interest on its own individual account. The illustrations being drawn from actual inspection, and greatly to the merits of the work, which abounds in practical instruction on mining geology.

PARLIAMENTARY PROSPECTS OF THE ENGINEERING INTEREST.

A change in the administration of the country being imminent, it is the bounden duty of the engineers, both civil and mechanical, to profit by the present state of affairs to obtain redress for their numerous grievances. No time can be more appropriate than the opening of a new parliament to canvass for a change in the Standing Orders of the House of Commons, and the formation of a ministry is a good opportunity for securing a sound system of government policy. When we consider the vastness of the interests involved, and the extent of influence at the command of the engineers, we entertain no doubt of a relief from the oppressions by which they have hitherto been afflicted. It may not be in the power of the engineers to meet together at this season and act in concert, but it is at least open to them to exert themselves individually in influencing the members for their several towns and districts, who may be called on to co-operate in a cause, which is nonpolitical, and of the greatest importance to the industrial interests of the country. It is perhaps fortunate that Sir Robert Peel has hitherto shown himself favourable to our interests, and we think that after the formation of a new ministry under his guidance, no time should be lost in ascertaining by a deputation of men of all parties the course he intends to take upon the momentous questions of the Standing Orders, Railways, Steam Navigation and the Irish Railways, so that the engineers might be able to take their measures accordingly.

MR. JOHN SCOTT RUSSELL'S TREATISE ON STEAM NAVIGATION.

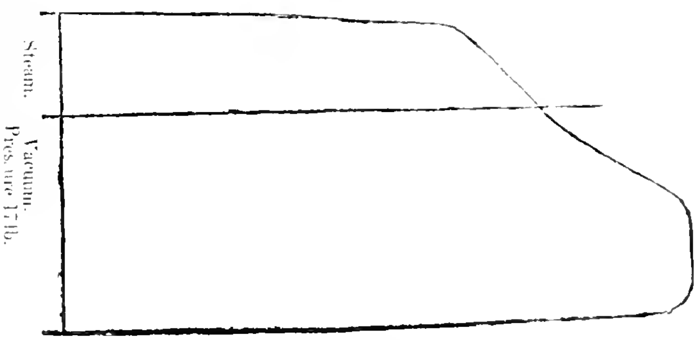
SIR—In a late Treatise on Steam Navigation, by John Scott Russell, I observed a statement regarding a steamer lately constructed on the wave-line principle, which ran thus, page 301, "the next and last vessel is the Flambeau, built in 1840, on the wave principle, by Mr. Duncan of Greenock, with the co-operation of the present writer. This vessel with the smallest proportion of power to tonnage, and with the smallest supply of steam, is nevertheless by far the swiftest vessel on the Clyde." Now I think "the present writer" ought not (although the vessel was constructed on the wave principle), to have allowed himself to go beyond the bounds of truth, I mean in the three last sentences. 1st. "She has the smallest proportion of power to tonnage." This is certainly doubtful, as you will see by the following indicator diagram, taken when at the speed of 21 strokes, (now she has many times made 27 strokes per minute), making 138 horse power: not as Mr. Russell has supposed, or rather wishes to make the world believe to be 70 only. Now taking her at 280 tons measurement, we have $\frac{280}{138} = 2$ tons per horse power. If that is the smallest, pray what may be the largest,—and yet with all this she was not by far the swiftest.

2nd. "With the smallest supply of steam." I understand the first boiler was not capable of supplying steam to the engine the whole length of stroke, so that they expanded one-third or 20 inches, as was intended, and pressed a little higher to compensate; yet so much was Mr. Russell disappointed with the speed of the vessel, that he attributed the deficiency of speed to the deficiency of steam, and accordingly with his usual tact, got the proprietors prevailed upon to put in another boiler that should follow up the steam, which they accordingly did, and pressed at about 6 or 7 lb.; the result was her speed diminished to Mr. Russell's mortification, and time, labour, and money lost to the proprietors.

3rd. "Is nevertheless the swiftest on the Clyde." With her first boilers I grant she was the swiftest last season, only when she made the 27 strokes, but this season she is not classed among the swiftest. Now this is a statement of facts, as Mr. Russell knows very well.

Cylinder 48 in. diam.
Stroke 5 feet.

$$\frac{48^2 \times .7854 \times 14 \times 240}{44000} = 138 \text{ horse power.}$$



Mean pressure 14 lb.

Your insertion of the above in your useful Journal, will oblige,
Your obedient servant,
H.

August 14, 1841.

REMARKS ON RAILWAYS REPORT AND EVIDENCE.—1841.

Sir—The report of the "Select Committee appointed to consider whether it is desirable for the public safety to vest a discretionary power of issuing Regulations for the prevention of Accidents upon Railways, in the Board of Trade: and if so, under what conditions and limitations;" together with the evidence upon which such report has been founded, has fallen under my notice, and with the view of adding my experience and reflections to the general fund of information upon railways, I request the favour that you will lay the following observations before the public at your earliest opportunity.

I am an engineer of 18 years' experience in my profession, and for the last 6 years have been intimately connected with railways, principally in endeavouring to introduce into the system various contrivances by which the public safety will be increased.

It has occurred to me as a matter of great regret that the Committee was not assisted, during its deliberation, by a practical engineer fully versed in the various railway details which were brought under its consideration, a practice which is quite usual in the Admiralty Courts, by which the testimony of the various witnesses would have been checked; for it is just evident, had such been the case, the extraordinary opinions and assertions advanced by some of them, would never have been broached, as it is clear, when the questions of the Committee were directed in such a way as to convict a witness from his own testimony, the party never failed to take refuge behind some technical details, into the peculiarities of which the Committee could not follow. A striking instance of this occurs in (Question 567) Mr. Brunel's evidence, who states as the probable cause of accident, "that perhaps a pair of wheels upon a train is slightly out of gauge, being too narrow, that in passing some guard-rail they get strained, and that when they come to a part of the line which is rather wide in gauge, they get off, and the train is delayed." Now every technical man of experience knows that if a pair of wheels be out of gauge, the fault is in the construction of the spindle, for if every spindle is made with a collar or shoulder, so that the back of the boss of the wheel butts against it, a method I invariably practice, if the wheel run round upon its axle it could never get out of gauge, so that *a regulation* providing that every axle should be made with shoulders would be a very wise and proper regulation, and would apply to all railways whatever.

In another part of his evidence Mr. Brunel states that amongst other causes of accident, "a policeman immediately runs up, and stands right in the way of the tail-lamp of the train, and the next train runs into it. Now the majority of persons would say, that if the policeman had done his duty, and showed a red light, and if the engine-man had seen the red light, there would have been no accident." If the policeman, in the case of accident, received positive instructions to run back 500 yards and hold his red light, so that the engineer of the succeeding train should not fail seeing it, this precaution, one which I have invariably insisted upon, under whatever case or form of accident, is, and would always be, an efficacious and proper *regulation*.

Mr. Brunel states, amongst other minor improvements, it would be better for the wheel not to touch the guard-rail; a man who knew any thing of a railway would then have inquired the use of the guard-rail, because, this being placed purposely to guard the wheel from the point on the opposite rail, if the wheel was not governed by it, it is useless—and there is no secondary use for it, as Mr. Brunel endeavours to make it appear in Ques. 604, and so far as the use and principle of the guard-rails go, it is the same in all cases *on all railways*.

There is another observation in the same answer, so palpably in the teeth of experience, that I cannot fail here to notice it, and that is the denial on the part of Mr. Brunel that railway improvements can be made by any parties excepting by those connected with railways. It would have been a proper question following this assertion, if Mr. Brunel had been asked whether his own father was originally a block maker, and whether the fact of his not being so would have been a proper reason for Sir Jeremy Bentham declining the encouragement due to Sir I. Brunel's very admirable machinery for making blocks by machinery—or whether the illustrious Watt was an engine driver, or before his improvements in steam engines he was actually accustomed to the management of steam engines—or whether Arkwright was a cotton spinner—or Mr. James, the father of railways, previously to his conception of railway extension, was intimately and exclusively connected with railway matters—and lastly the inquiry might have been made, what improvements have been introduced, I will not say invented, by *railway* engineers since the formation of the Liverpool and Manchester Railway, and in what respect this last mentioned railway differs essentially from a colliery railway that had been formed half a century before it.

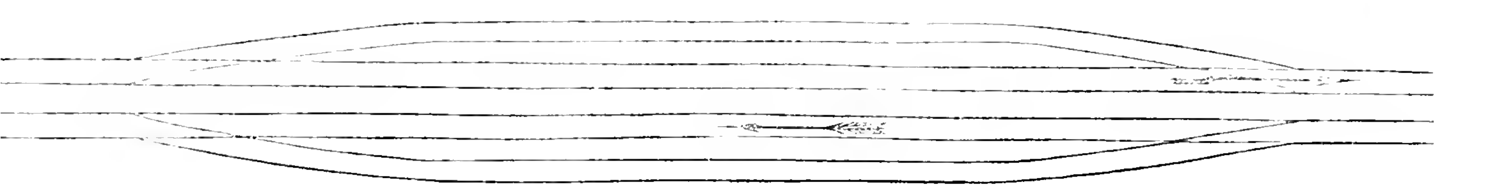
And whence does it arise that the improvement of railways, contrasts so essentially with the advances made by the great branches of trade, and manufactures, since their first introduction, but from the fact of the monopoly of the companies on the one hand, and the disinclination of railway engineers to introduce any contrivance which does not emanate from themselves, on the other: had a liberal spirit prevailed amongst engineers, and had they the judgment to select from the mass of crude suggestions offered to them, railways would have been by this time not only safe by contrast with stage coaches, but absolutely so, there is no reason why the system should not have been so formed as that, by no chance or design could an injury happen to passengers, and no one contrivance would conduce to this result more certainly and more directly than the adoption of the low carriage, upon the principle of those invented by myself, and in use upon the Greenwich Railway, and although Mr. Entwistle takes credit for the arrangements upon the Greenwich line, inasmuch as 6,800,000 passengers have been carried without the loss of life or limb to any one, he had not the candour to admit that this gratifying result is to be attributed mainly to the construction of the carriages, for the accidents from broken axles, &c., have been much greater upon the Greenwich line than upon any other in the country, and but for the low carriages, some most awful accidents would have resulted. I may here mention that the Board of Directors to which Mr. Entwistle belongs, have not only done their worst to disgust the public by the manner in which their carriages are kept, but they would have been long since abolished by the Directors but for the resistance made to that measure by the parties who are in the habit daily of using the line. This fact is one more in proof of the necessity of some supervising power to control the measures of railway managers.

The mode in which Mr. Brunel attacks the recommendation of Sir F. Smith that an engine should not be loaded beyond a certain amount, proves again the necessity that a technical judge should have been in communication with the Committee; in that case I can scarcely believe Mr. Brunel would have indulged in the same arguments. The power of a locomotive is resolvable into two elements, the quantity of water evaporated by it, and the gradients it passes over; therefore, instead of appealing to one of these elements, viz. the gradients, had Mr. Brunel included both, the proposition of Sir F. Smith would have proved a most reasonable one. Had Sir F. Smith's proposition been that the load behind an engine should bear a certain ratio with the area of the cylinders, multiplied by a certain constant, having a ratio with the average gradients of the line, it would have amounted to the very rule of every-day practice upon any railway whatever, and by making either of these ratios fully within the average working condition of an engine, he could have so defined his object as to have ensured the punctual observance of his rule by the railway companies, a rule to which no reasonable objection could be made.

The advantage resulting from massing the trains, by the average power being thus obtained from the engines connected together, is, in my opinion, a very questionable one: supposing a very heavy train has two engines a head, and that the last engine runs so *dry* as to be useless; supposing, likewise, that the train is at a considerable distance from a siding or watering place, or a station whence another engine can be obtained, the power of the engine in good order will be almost entirely absorbed in dragging the defective engine behind it, and thus, the entire load will be retarded, and perhaps dangerously so. Had each engine taken its own load, the defective engine with its load would have been alone delayed: and, talking of expense, it would have been much better economy that a disabled engine and a small load should have been left at the first siding out of Bristol, than that a good engine should be strained and worked violently, and a heavy train delayed a considerable time throughout its journey to London, deranging all the arrangements, and endangering the line throughout. As to the maximum velocity, that could be disposed of in the way before mentioned, for the word power is resolved into the same elements, whether it be employed for draught or flight.

Mr. Brunel states "that with the best assistance of professional men, and others whose whole time and peculiar capabilities are applied to the system, we find it difficult enough to make our regulations sufficiently general to apply even upon our own line, and that the great difficulty in drawing up any code of regulations always is, to make a good regulation which is sufficiently applicable in all cases even on our own line of railway." I will prove that this very desirable system of uniformity can be easily accomplished as regards stations, and that is, to form them in such way that neither trains nor passengers shall ever cross the line. Fig. 1 will explain this method, by which it will be perceived that sidings must be placed on both sides of the line, and the crossings in such way that a train enters and departs from the siding without *backing*, backing into a siding being unquestionably most gothic and unskilful, the only apology for it being

Fig. 1.



the incapacity of the engineer to construct a safe switch and point. The passengers will enter into the offices by a bridge over or under the railway, as the case may be: it will not be out of place here to remark upon the most injudicious and unscientific practice adopted upon the Great Western Railway, in common with many others, of laying all the crossings along the line in one direction, by which means it is indispensable to back the train across the line, and bring it consequently to a dead halt twice before it can pass upon the wrong line; the apology for this is, that the peculiar switches adopted require such an arrangement, in order that the train may pass over them safely, and in the case of the switch being placed improperly, the train not being liable to be thrown off the rails. My patent switches are formed in such a way as to meet this latter case, and have this additional value attached to them, that a train may pass over them in both directions at full speed with perfect security, the switch being so made as to form a perfect and unbroken line, whether laid for the main line or cross line; my patent point or crossing is likewise so made as to require no cut in the line, nor a guard-rail in the main line; both these contrivances are in use, and when they are more generally known, the practice under discussion will be, it is trusted, altered.

It is likewise self-evident, that if sidings of this form be placed at intervals along the line, swift trains may pass slow ones with perfect facility by the slow train entering the siding, and leaving the main line open to the fast train; thus neither train need stop, nor would there be any further delay than a slight retardation of the slow train whilst the switches were altered; but supposing a man kept on the ground on purpose to effect this alteration of the switch, there would be no necessity to reduce the velocity of either train.

Here, again, therefore, a very general and very judicious regulation might be introduced applicable to all railways.

Admitting the deep interest which railway engineers *ought* to have, and the deep breeches-pocket interest which railway directors *must* have in the perfect working of railways, there is another interest which the Committee was not, perhaps, aware of operating most powerfully against the introduction of improvement, and that is the jealous and selfish feeling of engineers against adopting the contrivances of a contemporary, however useful such contrivance may be, their interest is to let well alone, and to keep without censure.

It is surprising it did not occur to Mr. Brunel that in the case of a public officer recommending to one company the adoption of a valuable improvement made by another, the two parties would be in the same relative position in the event of the compliment being returned, by the first being required to reimprove its own improvement, because, if it were proper in one company to go to an expense to effect a certain object, it is still their duty and interest to incur expence to perfect their arrangements; perhaps he may not be aware how large a comparative amount of profits is sunk amongst manufacturers to perfect their processes, when the spur of competition urges one man to surpass his neighbours, but in the case of railways the same feelings do not operate, which is the most powerful reason of all others why this want should be supplied by the interference of the legislature.

I agree with Mr. Brunel that buffers are matters of secondary importance, and I hold them only useful to protect the carriages from injury when they are knocked about in the station: for any purpose of benefit to a train when in motion, I never could discover, inasmuch as the action and reaction of the engine and trains is fully provided for by the springs connected with the drag links, in fact, were carriages provided with merely two springs acting in reverse ways, so that when the carriages are arranged in trains, a buffer spring connects one end of the links, and a drag spring the other, and supposing the link inflexible, the most perfect ease would be produced in the carriage, and every provision made for any sudden retardation to which the carriage will be subjected. However, a buffer is a buffer, whether formed by springs or hair, or by any other elastic means.

Had Sir F. Smith been simply a man of invention, without any connexion with the Board of Trade, and had he not the means of making his suggestions respected, his treatment from railway companies and railway officers would have been the very reverse of that he has found it, and the fact that his suggestions are treated with respect is a most powerful reason that the public supervisor should be the vehicle through which suggestions should be made, otherwise my experience and that of numberless other men prove that their thoughts and their time will be exerted in vain, in fruitless appeals to railway companies or their agents.

Mr. Brunel's objection to the 15 minutes interval is fair and well-considered; such an arrangement is wholly impracticable, and if adopted might lead to accidents in another point of view than that stated: a train might break down a few minutes after it had left a station, the guards and engine-men might be killed or disabled, then supposing the night dark or foggy, the succeeding train would run upon it, and very sad results would ensue; but if signals such as I have contrived were adopted, and which have been since ably recommended by Sir George Cayley, formed in such a way that the engine should make its own signal, and leave notice a mile behind it, whether it had passed or not the next signal post a mile in advance; the engine man would be thus certain of being informed of the state of the line in advance, and supposing any disarrangement of the signal, no delay or embarrassment would arise beyond the caution necessary in proceeding a mile forward, or perhaps one or two minutes in that distance. This objection is, I conceive, conclusive against any signals acting by time, as it would most infallibly fail at those times it was wanted, viz., in cases of accidents in bad weather. Whilst upon the question of signals, I cannot but advert to the evidence of Mr. Entwistle on this subject; that more accidents have not happened upon the Greenwich Railway is indeed a most providential circumstance; what would become of the trains in the case of a foggy night, with a bleak driving storm of rain or snow and wind from the north-west, and what security would there be that the men would hear the approach of a train and pass it, supposing a Croydon train was coming from London, time enough for either the Croydon train to pull up, or the Greenwich train from Greenwich to do so, or both; because, assuming that Mr. Entwistle's 15 men were most advantageously disposed of, placing 5 men from the junction towards London, and 5 towards Greenwich, the other 5 towards Croydon, the men on the London side would have to pass the word 400 yards towards Greenwich before the Greenwich train could be advised, and then either the one or the other would require to be brought to a dead halt within 200 yards, or a collision would ensue. I very much doubt whether Mr. Entwistle would not have been puzzled had the question been put to him, when was the last occasion that he was aware that this plan had been adopted, and how many times since he had been a director of the Greenwich Railway?

My experience tells me that if Mr. Brunel employs a break to his tender and engine-wheels of sufficient power to drag or stop the wheels, he will very soon destroy both the wheels and engine and railway. If any one thing has been settled in the management of a railway, it is this very fact, that, to block the wheels is to wear a flat place in the circumference, which, whenever the break is applied, allows the wheel to revolve until this flat place comes in contact with the rail, and which, by every successive operation, becomes worse, then, when the break is released, the flat side strikes the rail with a violent blow, and to such an amount that I have known one case on the Greenwich line when nearly a dozen rails were broken, on one occasion, by a bad wheel, the cause of which arose from this most vicious practice; if, therefore, Mr. Brunel realizes his notion, he will have good reason very soon to alter his plan. It is unquestionably a good plan that a large rubbing surface should be opposed to the momentum of the train, but that this should be sought, not by blocking, destroying the wheels, but by an independent method, similar to that I have already patented, and published in your Journal.

Mr. Brunel's opinion of the class of men for engine drivers, and his disposal of book principles amongst them, is most excellent, both in its substance, and in the way he defines it. I cordially and fully assent to all he says on the subject, and only wish, for his own reputation, he could always see his position as clearly and state it as cleverly as he has done in this instance.

In thus fully and freely criticising the evidence of Mr. Brunel, I trust that gentleman will do me the justice to believe that the importance attached to his opinions is my apology for subjecting those opinions to rigid review, and the object of the Committee, viz. to provide for and secure the public safety, renders it a duty of every well-wisher to railways to use his best efforts to assist such object. I purpose continuing my observations in your next paper; meanwhile

I remain, Sir,
Your obedient servant,
W. J. CURTIS.

15. *Stamford Street, Blackfriars Road.*
July 22.

REMARKS ON MR. BARRETT'S OBSERVATIONS ON BARS, &c.

SIR—I have read in the July number of your Journal some observations by Mr. Barrett, on Mr. Brook's New Theory of Bars. Not having had time to peruse the work of the latter gentleman, I shall not presume as yet to form any opinion upon it; nor do I mean at present to make any remarks on Mr. Barrett's paper further than relates to a particular passage. Mr. Barrett says, "at the Neva, Gulf of Finland, the Narva, Dantzic, the Danube, the Nile, and many other places, the current without intermission (there being no *flood tide*) is perpetually running out at the rate of six, seven, or eight knots per hour, and yet the old entrances to these rivers have been blocked up by impassable bars, &c."—On this passage I will take the liberty to observe in the first place, that it presents one among too many examples of the confusion arising from hasty writing. Thus the names of rivers are mixed up with those of places in a way to render the writer's meaning rather doubtful. I presume, however, Mr. Barrett means to say—the Neva, at its effluence into the Gulf of Finland, the Narova, (not the Narva, which is a town) also at its egress into the Gulf of Finland, the Vistula (not named) at Dantzic, the Danube and the Nile at their entrance severally, into the Black Sea and into the Mediterranean.

And again, when Mr. Barrett says, "the currents of these rivers (at their embouchures understood) is perpetually running out at the rate of six, seven, or eight knots per hour, there being no *flood tides*," we are at a loss to understand whether the six, seven, or eight knots, refer severally to any three of the five rivers, and, if so, to which respectively, or whether the writer means that each of the five rivers has a current constantly running out without impediment, at the rate of from six to eight knots an hour, according to the season. The latter meaning seems to be the most rational. Now, with all due deference, I would observe, that the rivers mentioned differ so essentially in their characters that their currents must be very dissimilar, as must also the quantity and the quality (as regards sedimentary matter) of their waters. As to the Neva in particular, I know not whence Mr. Barrett has gleaned the incorrect information as to the rapidity of its current: but I beg leave to assure him, on the best authority, that its ordinary velocity, so far from being from six to eight knots per hour, is 27 inches per second, or $2\frac{2}{57}$ knots an hour. I cannot state with equal confidence the velocities of the other rivers at their embouchures, neither could I point out, without taking up much more room than you have to spare, the several particulars in which the rivers mentioned differ from one another; nor is it essential to my present purpose. The point to which I would specially draw attention is this.

According to Mr. Barrett, it is the deposit, by the outflowing waters of rivers, of the debris with which they are charged, that forms bars, whether there be tide or not, and in proof of this assertion, he gives as an instance among other rivers, the Neva. Now admitting the general correctness of his views on the formation of bars, it must be confessed he has been most unhappy in mentioning the bar at the mouth of the Neva as a case in point. The fact is, the Neva, of all rivers in the world, is the least obnoxious to the reproach of forming a bar to prevent ingress; on the contrary, she does all she can to open her mouth and invite entrance. True, there is a bar, but the materials of that bar are brought *not by the river* but by the sea.

The Neva at St. Petersburg is 50 feet deep, and, having deposited all impurities in the immense Ladoga, its waters are at all times, except when a strong wind blows in from the seaward for any continuance, as clear as crystal.

The head of the Gulf of Finland narrows gradually to the very mouth, or rather mouths of the river: accordingly when a strong wind blows in from the Gulf, a sea is soon raised whose waves, being pent in, cross and break, and, with the sand stirred up from the bottom rush for escape to the open mouths of the Neva, where being met by the obstacle of the descending current of the stream (bearing along in its main stream a mass of 115,000 cubic feet of water in a second) there naturally results an annihilation of force and a deposit or bar of sand. This being the fact, I am sure Mr. Barrett will see the impropriety of bringing in the Neva in support of an argument to which it does not apply.

The truth is, a bar or deposit will ever be formed where two bodies of water meet, and one or both is charged with detrital matter; but in many cases it is the *sea*, and *not the river* which furnishes the whole of the material of the bar, and in almost every case, I believe, it brings its quota to the mass.

In conclusion, Sir, for I have already trespassed too far, I would say, the subject of bars is a most interesting and a most important one; but those who discuss it cannot be too careful in the choice of facts in support of their arguments if they would not furnish weapons against themselves.

I am, Sir, your most obedient servant,
J. R. JACKSON.

P.S. As connected with the subject of bars and sand-banks, I cannot refrain from adverting to a common error which is being continually repeated by persons writing on these matters, viz., that the sand of rivers and that on the sea beach, results from the trituration of the stones rolled by the stream or agitated by the waves. Now Mr. Editor, it is physically impossible that sand can be formed in this way. Sand is an original formation, and all that running water and waves do or can effect is, to wash away the lighter matter, and leave, or carry away, and deposit the sand in particular places. Trituration in the beds of rivers and on the beach, will wear away stones and rocks and polish them, and the result will be a fine impalpable powder, but not one particle of sand will be formed in the process, were it to continue till doomsday. It is high time this egregious error was exploded; an error which could never have gained credit but for that unaccountable indolence of mind which leads so many to take every thing for granted without a moment's reflection.

J. R. J.

ON CANDIDUS'S REMARKS ON THE LECTURES OF THE PROFESSOR OF ARCHITECTURE.

PROFESSORS, whether of architecture or any other art or science, are undoubtedly public men, and as such are open to the most unlimited criticism; but, by the same rule, the critics must submit to be attacked in their turn, if any one of the public should think proper. But it should be remembered that abuse is not criticism, and that more effect will be produced by clearly pointing out errors than by the use of "damnable" expressions, which is the style I alluded to, and which will be found scattered occasionally through the fasciculi. I should not, however, have noticed it, had not Candidus been so much in the habit of boasting of his freedom of speech, which, however, by his own confession, avails but little, as it is evident he might as well "try to tickle a rhinoceros with a rose leaf" as attempt, with a one Candidus power, what it would require sixty to effect.

The possibility of treating Gothic architecture properly so as to conduce to comfort, is still unproved. I find repeated the bare assertion of the necessity for treating it with intelligence and ability, but no evidence produced to show that the greatest ability can lead to satisfactory results.

If no more was to be expected from Grecian and Roman than is to be found at the British Museum and other works by the same architect or others of his school, I should then call for Gothic or any other style to save us from such insipid abortions, which are, at any rate, as bad as facsimilies of Gothic, and much worse, inasmuch as they have been so much more often repeated; but I have a higher opinion of the resources of those styles than to believe such to be the case, and from some former remarks of Candidus, I think he will agree with me in that point at least. I shall make no comment on the preference apparently given to the spire of St. George's, Bloomsbury, over that of Bow Church; such an assertion would require more boldness than even Candidus is gifted with—it can therefore be only a mischievous insertion of the printer's devil.

Barry has taken up Gothic architecture with an originality of conception to be found in no other architect—but even his success will not warrant the assumption that we shall ever be able to incorporate the principles of the style with the habits of the present day. At the period at which this style flourished, it followed a regularly progressing course, commencing with the Norman. This was gradually improved upon till it resulted in the early English, which, by further modifications, became that of the decorated period, the most perfect of all. From that time it increased in richness and exuberance, but declined in purity till it was worn out in the reign of Henry VIII. Now I cannot see how we can, with advantage, dip down into any one of these styles at pleasure, and follow it out in the spirit in which it was then followed, and in which is the only hope of success. It is like transporting the trees of the tropics into this country, where only the most assiduous attention can keep them alive—nothing can ever make them equal in beauty the natural growth of the trees of our own forests, though in their native climate they may as much surpass them as they now fall short.

S. L.

THE ROYAL ACADEMY.

SIR—I am very glad to perceive that painters as well as architects, are at length beginning to remonstrate against the truly preposterous system of hanging pictures and drawings at the Royal Academy. Let us hope that what has lately been said on the subject both in your own Journal, and the Art-Union, will now shame the Academy into common sense, and deter them in future from taking in more works than can be properly seen when hung up.

Of course this would contract their catalogue to about one-half its present extent—in which case it might be sold to the public at half its present price,—but both the public and artists would be benefitted by the reduction—I do not mean of the price of the catalogue, but of the dense throng of pictures and drawings, the majority of which are annually put out of sight, by being *exalted* to disgrace—to their own disgrace and to that both of the Hanging Committee in particular, and of the Academy generally.

Still it is very doubtful whether the expostulations and remonstrances that have been made will produce any effect, unless repeated from time to time, and dinned in the ears of the Academicians, until they can no longer affect to be ignorant of them. Did the matter rest entirely with the President, the evil complained of would no doubt be remedied at once, but I suspect that like some other great personages, he is no more than "the puppet in the chair," and permitted to fill it on the condition of his napping in it, and not interfering with those around him. Though those composing them may be well-intentioned and reasonable people, corporate and public bodies are almost invariably shameless, and do not scruple to do in their united capacity, what hardly one among them would dare to sanction, defend, or justify individually and personally.

In the course of his remarks, the writer in the Art-Union attributes some portion of the present absurd system of hanging pictures in our public exhibitions, to the want of better contrivance and arrangement on the part of architects who build the rooms. Herein he is partly right, but he is assuredly mistaken if he supposes that, as far as architectural appearances is concerned, any thing would be lost were the rooms to be designed in such a manner as to render it impossible to put any pictures at more than a moderate height above the eye. On the contrary, as much might be gained in point of architectural effect as of positive convenience; since it would not be at all requisite that the proportions of the rooms, as to height, should be altered, or their ceilings an inch lower than at present. All that would be necessary is that no more than a proper altitude should be allowed as the available space for hanging pictures on the walls, (which might vary in the different rooms accordingly as they are intended for small or large paintings); and from that height the architectural decoration of the upper part of the walls and ceiling should commence. By this means the general appearance would be very greatly improved; and instead of the broker's-shop and picture-dealer's-warehouse look, which now so disagreeably characterises all our exhibition rooms, there would be an air of elegance and spaciousness,—of there being room enough and to spare without *stowing away* a number of pictures, piling them up to the very ceiling, when they might just as well be poked into a lumber garret at once.

In short, let the Academy and other exhibiting Societies break up their *Lumber Troop* corps, dismiss their host of supernumeraries, and instead of surfeiting their visitors with an annual cram—consisting of a good deal of trash, give us much less as to quantity, and much more as to quality.

I remain, &c.,

COMMON SENSE.

PILBROW'S CONDENSING CYLINDER STEAM ENGINE.

THIS is a contrivance intended, according to a pamphlet written by Mr. Boyman Boyman, to save the loss of power occasioned by the imperfect exhaustion of the cylinder in steam engines of the ordinary construction, and by which Mr. Pilbrow considers that he will save *more than half* the fuel of Mr. Watt's Rotative engines. The author of the pamphlet in question, however, dispels at the very outset the illusion as to the extent of saving by stating that Mr. Watt estimated the mean resistance of the unexhausted steam at 4 lb. per square inch, in an engine loaded so as to exert its intended power, the steam being 2½ lb. less than the atmosphere. In this case the pressure of the steam is 2¼ lb., from which deducting 4 lb. for imperfect exhaustion, and 1¾ lb. for friction (as at page 28) there remains an effective pressure of 6·46 lb. The pressure in the condenser at a temperature of 100 is 1 lb., therefore the limit of what may be saved by Mr. Pilbrow's arrangement is 3 lb. per square inch, which is the entire loss resulting from the exhaustion in the cylinder being less perfect than in the condenser; but if the whole of this were saved, the load of the engine being increased, the friction would be so likewise, and the effective pressure would become, say 9·09 lb., and the saving of fuel would be less than 29, instead of more than 50 per cent., as anticipated by Mr. Pilbrow. It is evident that the loss in question would not rise in the same proportion as the pressure of the steam employed, particularly when it is expanded in the cylinder, which is now pretty generally done to a greater or less extent, and we are persuaded that Mr. Farey must have overrated the resistance of the unexhausted steam, where it is used at 3½ lb. above the atmosphere, when he estimated it at 5·71 lb.; but even with this allowance the consequent loss of duty amounts to no more than 29 per cent. It should be observed that this is the *whole* loss due to imperfect exhaustion in the cylinder, which can certainly not be saved by Mr. Pilbrow's arrangement, though he considers that it is.

Little need be said of the theory of condensation, as it is called, laid down at pages 19 and 20, which is very little of a theory, and nothing at all to the purpose; but since it is dragged in, as it were, in confirmation of the advantages of the Condensing Cylinder Engine, we shall merely show that the inferences intended to be drawn from it are erroneous.

The theory of condensation is that "steam can only be condensed as fast as it rushes from the cylinder to the condenser, as far as the injection can enter, and as fast as the water, or cold surface, can absorb all the caloric of the steam." Mr. Boyman concludes that "if the vacuum gauge shows, whilst the steam is being condensed, a less mean vacuum in the condenser than what is due to a temperature of 100°," (considered by Mr. Watt as a fair average), "it shows that the steam has flowed quick enough to the condenser, and is there waiting to be condensed," and that "no increase of eduction valve would, therefore, cause a quicker annihilation of the steam, to give a better mean exhaustion of the cylinder, for it is already large enough to permit its escape as fast as a certain quantity of water can take up its caloric." But what is the just conclusion to be drawn from the above circumstance?—Simply that there is not sufficient injection water to reduce the condensement to the required temperature; a knowledge of the actual state of exhaustion in the cylinder would alone show whether the steam flowed fast enough into the condenser. Mr. Boyman harps continually on one string—the impropriety of reducing the condensement to a lower temperature than 96° or 100°, and pretends to conclude therefrom that no better cylinder exhaustion than was obtained by Watt can be achieved with the ordinary air pump, separate from the condenser.

The long discussion of the comparative performance of Mr. Watt's rotative engines and the present is irrelevant, and we shall therefore discuss it with one or two remarks.

After extracting Mr. J. S. Russell's proof of the fallacy of the opinion that the better the vacuum the greater is the duty, the author informs his readers that "the above formula is given because it confirms the general principle, that more is lost than gained by a vacuum *beyond certain limits*. It does not embrace," he says, "the principles of condensation, but has reference simply to temperature; not," he continues, "that this theory is supported by the practice of Cornish engines, where the greatest duty is performed with the greatest vacuum."

If, then, this theory is not supported by facts, how can it be said to confirm the general principle?

In speaking of the *extraordinary* Indicator diagrams of the present day, (which seem to puzzle Mr. Boyman exceedingly, because they show that Mr. Farey's observation, made 14 years ago, is not applicable to engines of the present day, namely, that "the modern engines are, by their construction, less capable of speedy exhaustion of the cylinder than the original construction"), he mentions that in the diagrams of the *British Queen*, where a mean cylinder exhaustion of 12·3 lb. is shown, the condensement is reduced to the temperature of the external water, but he does not seem to be aware that *the condensing water left the condenser at a much higher temperature*, which it must have done, or it could not have condensed the steam. It is however certain that, whatever may have been the state of the vacuum in the upper part of the condenser, where the steam from the cylinder entered it the mean difference between it and the mean cylinder exhaustion *cannot possibly* have amounted to 2.41 lb., the external barometer standing at 30 inches, as that would indicate a perfect vacuum, which is obviously impossible.*

In Mr. Pilbrow's engine the ordinary condenser and air pump are replaced by a double-acting air-pump of the same size as the steam cylinder, called the condensing cylinder, in the interior of which the condensation is effected by injection alternately above and below the piston, which is of course solid, like the steam piston. The two cylinders are connected at top and bottom by passages, with valves to open and close the communication alternately. The action will be as follows: while the steam piston is ascending, the air-pump piston is descending, and the two cylinders communicating at top, the steam which performed the previous down stroke will flow into the condensing cylinder, and be condensed by the jet, by which, as we know from the experience of ordinary condensing engines, the vacuum above the air-pump piston will be maintained at nearly its maximum, while the exhaustion of the cylinder will be nearly the same as in ordinary condensing engines. Mr. Boyman however supposes that, "during its condensation, the uncondensed steam will keep giving to the condenser piston, until completely annihilated, just as much power as it offers resistance to the effective action of the steam piston." The exhaustion on the under side of the condenser piston will be the maximum throughout the stroke, so that the resistance to the motion of the steam piston (exclusive of friction and the resistance to the discharge of the condensement in the latter part of the stroke) will be equal to the mean pressure of the used steam remaining in the steam cylinder *minus* the difference between the maximum and mean exhaustion in the condenser, and this difference, which is quite insignificant, is, after deducting the surplus power required to work his large air-pump, the true gain of power obtained by Mr. Pilbrow's contrivance, and we think it probable that after the deduction the gain will be found to be negative, or a loss.

* It may be as well to observe here that the difference between the exhaustion in the cylinder, and in the condenser is independent of the mode of condensation: and that consequently, if by any improved process the vacuum in the condenser be increased, the cylinder exhaustion must be so too.

CARBONIC ACID GAS VERSUS STEAM.

(From "Buckingham's America.)

Towards the close of our stay in Philadelphia, I had an opportunity of attending one of the chemical classes of my friend Dr. Mitchell, and witnessing there a most interesting experiment for the rendering carbonic acid gas solid, and for producing by it a degree of cold, extending to 102 degrees below zero, on the scale of Fahrenheit's thermometer. The materials, first confined in a strong iron receiver, were, super-carbonate of soda and sulphuric acid, in separate divisions; the whole was then powerfully shaken, so as to be well mixed or incorporated, and this operation continually evolved the gas, till the whole vessel was filled with it in a highly condensed state.

An instrument not unlike a common tinder-box, as it is used in England, but about twice the size, and with a small tube of inlet passing through its sides, was then fixed by this tube to a pipe from the receiver. The inside of this box was so constructed as to make the gas injected into it fly round in a series of constantly contracting circles, which was effected by projecting pieces of tin at different angles, fastened around the sides of the interior. The gas being then let out by a valve, entered this box from the receiver, making as loud a hissing noise as the escape of steam by the safety-valve of a large boiler, and in about three or four seconds the emission of the gas was stopped.

The box was then taken off from the receiver and its cover opened, when it was found to be filled with a milk-white substance, in appearance like snow, but in consistence like a highly-wrought froth, approaching to a light paste. It was surrounded with a thin blue vapour like smoke, and was so intensely cold, that the sensation of touch to the fingers was like that of burning; and the feeling was more like that of heat than cold. The slightest particles of it dropped on the back of the hand, and suffered to remain there, occasioned a blistering of the skin, just like a scald; and some of the students of the class who attempted to hold it in their fingers, were obliged to let it drop as if it were red-hot iron.

Some liquid mercury, or quicksilver, was then dropped into a mass of this "carbonic acid snow," as it was called, mixed with ether, upon which it instantly froze, and being taken out in a solid mass, it was found to be malleable into thin sheets under the hammer, and capable of being cut up like lead, with a knife or large scissors. As it became less cold it grew more brittle, and then, when pressed strongly by the thumb or finger against a solid substance, it was found to burst under the pressure, with a report or explosion like the percussion powder.

A small piece of this carbonic acid snow was placed on the surface of water, where it ran round by an apparently spontaneous motion, and gave out a thin blue vapour like smoke. Another piece was placed under the water, and kept beneath it, when it emitted gas in an immense stream of air-bubbles, rushing from the bottom to the top; thus returning, in short, from its solid to its original gaseous condition. Some of the snow was then mingled with the well-known "freezing mixture," and by stirring these both together, a degree of intense cold was produced, extending to 102 degrees below zero, and there remaining for a period of ten or fifteen minutes; though the weather was extremely hot, the thermometer standing at 94 degrees in the shade, in the coolest parts of Philadelphia, and being at least 90 degrees in the lecture-room itself.

The practical application of this discovery to the propelling of engines in lieu of steam, was then exhibited to us. A model of an engine of the ordinary kind now in use for mines, manufactories, and steam-ships, was placed on the table before the lecturer. A metal tube was then screwed on to the pipe and valve of the receiver, in which the condensed carbonic acid gas was contained, and the other end of the tube through which the gas was to escape, when let into it from the receiver, was applied to the wheel of the model engine; the gas was then let out, and the rushing torrent of it was such as that it propelled the engine wheel with a velocity which rendered its revolutions invisible, from their speed, making the wheel appear stationary, though in a trembling or vibratory condition, and rendering all perception of the parts of the wheel quite impossible till the gaseous stream which gave the impetus was withdrawn.

Dr. Mitchell expressed his belief that this power might be made to supersede entirely the use of steam and fuel in navigation, and thus overcome the greatest difficulty which has yet impeded long voyages; he thought it might effect the same salutary change in manufactories where engines are used, so as to remove the greatest nuisance, perhaps, of all manufacturing towns, the immense quantities of smoke which darken the atmosphere, and destroy the cleanliness of places, persons, raiment, and dwellings. He founded his belief on the expansive power of this gas when brought into a highly condensed state, such as we saw it, and the practicability of bringing this power to act upon engines of any size by land or by sea. For the latter purpose he suggests the use of iron tanks, made with the requisite degree of strength, to act as receivers; these being fitted to a ship's bottom, along the keelson and the inner floor of the hold, as the iron water-tanks of ships of war are at present, it may be placed on board vessels intended to be propelled by engines, in such quantities as the length of the voyage may require; communications from these tanks, by tubes of adequate size and strength, would then have to be made to the engines, and placed under the complete control of the engineer, as the steam-power is at present. The expansive power of the condensed gas, and its pressure outward, or tendency to escape, being the same in its nature with steam, but greater in degree, the application and direction of this power would effect all that steam now does, and thus supersede the use of fuel, with its inconveniences and accidents, entirely.

In reference to the expense, Dr. Mitchell had made such calculations as to satisfy him that it would be cheaper than the present materials of steam navigation. The Great Western steamer, in coming from London to New York, actually consumed 600 tons of coal, which, at the lowest possible estimate, could not cost less than £1000 sterling, or 5000 dollars. But as it was necessary to provide for a longer voyage than that actually performed, in case of accident or delay, no less a quantity than 800 tons were taken on board, and consequently 800 tons of space were wholly lost, or rendered unproductive, by its appropriation to fuel. The expense of the requisite quantity of gas for such a voyage, including all the fittings, would not, he thought, exceed that of the coals and requisite machinery; and the saving of the space, for freight, would be a source of considerable profit; while the avoidance of the heat and smoke, inseparable from fuel and steam, the absence of boilers and chimneys, and the safety from accidents of bursting and taking fire, would be all such high recommendations to passengers, that none would venture to embark in steam-ships while those propelled by carbonic acid gas were available.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

March 16.—The President in the Chair.

"*Description of two Wrought-Iron Roofs over the buildings at Mr. Thomas Cubitt's Works, Thames Bank.*" By Mr. Adams.

This communication describes in detail the construction, and gives the dimensions of the several parts of two fire-proof roofs of 29 feet span, one of which bears, in addition to the covering, a ceiling of tile arches upon iron girders, the weight of which is equal to 5 tons 4 cwt. upon each truss.

The paper is accompanied by two drawings of the roofs.

"*Description of a Double Telescope Theodolite.*" Arranged by Nathaniel Beardmore, Grad. Inst. C.E.

The improvement in this theodolite consists in its having a second telescope fixed over the ordinary one, in a reverse position, so that the line of collimation of the two telescopes when properly adjusted should be the same. The principal advantage gained is, that a straight line may be carried out with perfect accuracy, without the tedious and uncertain process of adding 180 degrees to the observed angle and reversing the instrument. A drawing of the instrument accompanied the communication.

"*On setting out Curves for Railways.*" By R. C. May, Assoc. Inst. C.E.

The method of setting out curves proposed in this communication is founded upon the 32nd Prop. of the 3rd book of Euclid. It consists in cutting off by a chord a segment of the circle to be described, and then finding any number of points in the curve by means of a reflecting instrument, which is set so as to reflect the angle in that segment.

The instrument which has been adapted by the author for this operation, consists of two plane mirrors, the upper one being fixed vertically upon a disc of brass, and the lower one fastened to an arm which turns upon its centre, and permits the two mirrors to be set at any angle with each other: the arm can be fixed by a clamp screw. In the case surrounding the mirrors are two holes, for admitting light, and between them is the sight hole, placed so as to bisect the angle formed by the mirrors. From the underside at the centre of the instrument is suspended a slender wooden rod, with a pointed end, weighted with lead.

Angles are taken with the instrument in the same manner as with the box sextant. To determine any point in the curve, the instrument when set fast is placed in such a position that the two given objects coincide in the mirrors, and the weighted rod being released by withdrawing a bolt, falls directly beneath the centre of the instrument, marking the required point in the curve.

The author presented with this paper a Reflecting Instrument, and field tables of chords and segments to be used in setting out curves by this method.*

March 23.—The PRESIDENT in the Chair.

"*An improved Plank Frame, for sawing Deals and Planks of various thickness into any number of boards.*" By Benjamin Hick, M. Inst. C.E.

The principal improvement in this machine is a novel kind of gearing for producing what is usually termed the "taking-up" or "traversing motion" of the plank during the operation of sawing.

A revolving motion is given to two pair of coupled vertical fluted rollers, by means of worms and wheels, which are worked by a ratchet wheel and catch, from the crank shaft of the machine. When a plank is introduced between the moving rollers and the fixed guides in the centre of the machine, the tendency of the motion is to draw the plank forward at each stroke, with a force exactly corresponding to the degree of resistance opposed by the teeth of the saw. By this means, the necessity of any other support or side roller to the plank, during its progress through the machine, is avoided, and any number of planks of different length, depth, and thickness, can be put through the machine after each other, without any alteration or stoppage of the work.

Several minor improvements are introduced in the general arrangement of the machine, particularly in the position of the crank shaft and connecting rod, which latter is placed in the centre of the moveable frame, occupying a space which has not hitherto been made use of in machines for cutting two planks simultaneously; and by carrying the crank shaft upon the framing, instead of having it fixed upon a separate foundation, the construction is simplified as well as rendered less expensive.

The communication was accompanied by a working model of the machine.

"*An historical Account of Wood Sheathing for Ships.*" By J. J. Wilkinson.

This communication commences with the earliest history of naval architecture, the different modes of construction, and the precautions taken for the preservation of the vessels from the attacks of marine animals.

A very early instance of extraordinary attention to the preservation of the bottom of a vessel appeared in a galley supposed to have belonged to the Emperor Trajan, A. D. 98 to A. D. 117, which was found in the fifteenth century in the lake Hemorese (or Lago Riccio), in the kingdom of Naples, and was weighed after it had probably remained more than 1300 years under water; it was doubly planked with pine and cypress, coated with pitch, upon which there was a covering of linen, and, over all, a sheathing of lead fastened with nails of brass or copper; the timber was in a perfectly sound state.

In the reign of Henry VIII. large vessels had a coating of loose animal hair attached with pitch, over which a sheathing board of about an inch in thickness was fastened "to keep the hair in its place."

It is believed that the art of sheathing vessels was early practised in China: a mixture of fish oil and lime was applied; it was very adhesive, and became so hard that the worm could not penetrate it.

The opinions of Sir Richard Hawkins, of François Cauche, and of Dampier, on the practice of wood furring, are then given at length, with extracts from their journals.

The sheathing the bottoms of ships with timber, appears to have been disapproved by these early navigators. In 1668, the officers of the fleet, then preparing under Sir Thomas Allen for an expedition against the Algerines, petitioned that their vessels might not be thus encumbered, as they were in consequence always unable to overtake the light-sailing unsheathed vessels of the enemy; the petition was granted, upon the condition that precautions should be taken by cleaning the ships' bottoms very frequently.

In 1670 a patent was granted to Sir Philip Howard and to Major Watson, for the use of milled lead sheathing; it was not, however, introduced without difficulty; nor until an order was issued that "no other than milled lead sheathing should be used on his Majesty's ships." About the year 1700 the lead was acknowledged to have failed, and wood sheathing was again introduced.

Numerous instances are given of the employment of wood as sheathing for ships in celebrated expeditions: the ravages of the worm, the accumulation of barnacles and weeds, are then described; the qualities of the wood employed for sheathing in different countries, both formerly and up to the present time, are examined, and the author, who undertook the investigation of this subject in consequence of finding how little good information existed in an accessible form, promises the history of metal sheathing in a future communication.

"*A Machine for bending and setting the Tire of Railway Carriage Wheels.*" By Joseph Woods, Grad. Inst. C. E.

The usual mode of bending tire bars was by means of swages and hammers round a fixed mandril; after being welded, they were stretched on a cast-iron block formed of two semicircular pieces hinged at one point, and wedged apart at the opposite side; the hoops being heated were placed on this block, and by repeated blows driven into close contact with the mould.

Much difficulty was experienced in thus making up tires for large railway wheels, and the present machine was constructed for facilitating the process.

One end of the tire bar when heated is wedged into contact with one of four segments of a circle, of the required diameter, upon a cast-iron table, which is caused to revolve slowly; the pressure of a guide wheel at one side forces the tire bar to warp round the segments, and to form the circular hoop required; its ends having been previously scarfed, are then welded together.

The tire is again thoroughly heated and placed around the four segments, which slide radially on the table, and are then simultaneously forced outwards by a motion of the centre shaft.

The tire being slightly chilled, and assisted by the swage and hammer, soon adapts itself to the segments, and forms a circular hoop instead of two semi-circles irregularly joined at their points of contact, as by the old system; it is then ready for being chucked on the lathe, and bored out before shrinking on the wheel.

It is apparent that a machine of this description becomes applicable to tires of any diameter, by having three or four sizes of segments adapted to the table. It is found to diminish the manual labour, and to prepare the tire more accurately than by the usual process.

A model of the machine, and a detailed drawing of the several parts, accompanied the communication.

"*On the improvement of the Roads, Rivers, and Drainage, of the Counties of Great Britain.*" By Robert Sibley, M. Inst. C. E.

The author had on a former occasion drawn the attention of the Institution to the subject of a Bill before Parliament, "for the better regulation and general improvement of the Drainage of the Country;" and at the same time pointed out the course pursued by the magistrates of the County of Middlesex, in procuring with his professional assistance an accurate account of the Rivers, Bridges, &c., hoping that it might lead to similar surveys in other counties.

In the present communication he investigates the nature of the works which each county may be expected to undertake, and the means of accomplishing them economically, so that real public benefit may accrue.

The objects principally requiring the attention of the county magistrates, he considers to be, First—Facility of intercourse by the improvement of the roads, bridges, rivers, and canals. Secondly—Protection from injury by the passage of the waters from or through the county; and Thirdly—The removal of causes tending to vitiate the atmosphere, or to render unwholesome the water used for the support of human life.

All these points, which do not appear to have been fully comprehended in the Sewage Acts, are examined at length, and suggestions are offered for their regulation, with examples of the effects resulting from their neglect.

The advantage of placing the water-courses of the country generally under a well regulated system of management, is insisted upon as the most effectual mode of guarding against the destruction of property, and not unfrequently of human life, which ensues from the effects of sudden inundations, such as have recently occurred in the county of Middlesex.

March 30.—The PRESIDENT in the Chair.

"*Description of a new Universal Photometer.*" By Dr. Charles Schafhaeutl of Munich, Assoc. Inst. C. E.

The inadequacy of the photometric instruments invented by Pictet, Rumford, and others, is universally acknowledged. The bromide of silver, as used by Sir John Herschell, although extremely sensitive, is only slightly affected by artificial light.

These circumstances induced the author to complete the present instrument,* which he contemplated about twelve years since.

* This paper, with enlarged field tables, has been published by the Author, with the permission of the Council of the Institution, to accompany the instrument.

* The instrument was constructed by Mr. E. M. Clarke, 428, Strand.

The intensity of the undulations of gaseous fluids, as well as that of the air, is proportional to the amplitude of the oscillations, or more properly to the square of the amplitude.

A wave of light striking the retina must create a similar vibratory motion in the nerves of the retina, because the velocity of the molecular movement of the nerves depends upon the force with which they have been struck by the original wave, and if this velocity could be measured, it would show at the same time the intensity of light.

It is scarcely possible to obtain a direct accurate measurement of this velocity, but if the time during which the vibratory motion of the nerves ceases, be ascertained, the velocity of the vibrating molecules, and therefore the intensity of light, may be determined; because the duration of an impression on the retina is dependent on the resistance which the molecules of the nerves oppose to every force striking them; but as this resistance of the nerves increases as the square of the velocity, four times the momentum or intensity is necessary to double the time of duration; or, in other words, the intensity of the pencil of rays is as the square of the time of the duration of that impression made on the nerves of the retina.

The new photometer consists of a brass bar fixed vertically in a stand, carrying at its upper end a small tube in two parts, which may be lengthened from 5 to 10 inches if requisite. This eye tube has at each end a sliding plate pierced with holes of corresponding diameters. From the bottom of the bar a projecting arm sustains the lower end of a strip of rolled steel 18 inches long, $\frac{5}{16}$ths inch broad, and $\frac{1}{32}$nd inch thick; this has at the upper end a thin plate pierced with a small hole, corresponding with the holes in the sliders, and standing $\frac{1}{8}$th of an inch from one of them: upon the main bar is a prism with a slit in it, through which the strip of steel passes; this prism can be moved up or down by a rack and pinion, so as to lengthen or shorten the vibrations of the strip.

The method of using the instrument is to adjust the two holes at the opposite ends of the horizontal eye tube, so that they perfectly correspond, and do not permit any rays of light to enter, unless the plate at the extremity of the spring be pushed aside. The light to be compared is then placed at a certain given distance behind the plate, so that by bringing the axis of the hole which is pierced in it into the axis of the tube, a small pencil of light may enter the pupil of the eye. The prism is then placed at 100 of the scale on the side of the brass bar, and the steel strip caused to vibrate gently. A luminous disc immediately appears, accompanied by scintillations, which are caused by the impressions on the retina being interrupted by dark intervals: the prism is then gradually raised until the length of the vibrations of the strip being diminished, and the velocity increased, the luminous disc appears perfectly steady and clear. The length of the vibrating portion of the strip is then read off by the verniers marked on the brass rod, and compared with the whole length of the spring, measured from 100, which is considered as unity. The number of the vibrations to be computed from the found length of the spring, are inversely to the numbers of vibrations of the whole length, as the squares of their relative lengths. Hence are constructed the formulæ for calculation, which are given at length in the communication.

A fresh luminous impression is made on the retina as often as the circular aperture in the screen on the top of the spring cuts the axis of the tube. If the duration of the small vibration of the nerves of the retina is shorter than the time of a vibration of the spring, a dark interval appears between the two luminous impressions. In this case the vibration of the spring is shortened until the next impression returns just as the first ceases, and therefore the dark interval disappears; then by measuring the length of the shortened spring, the number of vibrations can be computed, and from them the intensity of the light.

This communication was illustrated by a series of experiments upon different lights, with the Photometer which was presented by the author to the Institution.

"*On the circumstances under which the Explosions of Steam Boilers generally occur, and on the means of preventing them.*" By Dr. Schafhaeutl, of Munich, Assoc. Inst. C. E.

Explosions of Steam Boilers.—In this communication it is assumed, that perhaps not one-tenth of the recorded explosions of steam boilers can be correctly attributed to the overloading of the safety valve, or to the accumulation of too great a quantity of steam in the boiler. The author alludes to the degree of pressure which hollow vessels, even of glass, are capable of sustaining, if the pressure be applied gradually. He found, in repeating the experiments of Cagniard de la Tour, subjecting glass tubes of one or two inches in length, one-fourth part filled with water, hermetically sealed, and immersed in a bath of melted zinc, that they apparently sustained the immense pressure of 400 atmospheres without bursting; but if the end of an iron rod was slightly pressed against the extremity of the tube, and the rod caused to vibrate longitudinally by rubbing it with a leather glove covered with resin, the tube was invariably shattered to pieces.

Hence he concludes, that something more than the simple excess of pressure of steam in the boiler is necessary to cause an explosion, and that a slight vibratory motion alone, communicated suddenly, or at intervals, to the boiler itself, might cause an explosion. From the circumstance of safety valves having been generally found inefficient, he concludes that a force has operated at the instant it was generated in tearing the bottom or sides of the boiler, before it could act upon the safety valve.

From the sudden effect of this force, explosions have been ascribed to the presence of hydrogen, generated by the decomposition of water; but independently of the difficulty of generating a large quantity of hydrogen in such a manner, it could neither burn nor explode without the presence of a certain quantity of free oxygen or atmospheric air; and such an explosive mixture would not take fire, even if mixed with 0·7 of its own volume of steam.*

Sudden conversion of Water into Steam.—The ordinary mode of converting water into steam is by successively adding small portions of calorie to a relatively large body of liquid; but if the operation was reversed, and all the heat imparted to a given quantity of water in one unit of time, an explosive force would be developed at the same moment. For example, if a bar of iron be heated until it is coated with liquid slag, and is then laid upon a globule of water upon an anvil, and struck with a hammer, the liquid slag communicates its caloric instantly to the water, becoming solid at the same time that the water is converted into vapour with a loud report. A similar occurrence may take place in a steam boiler when a quantity of water is thrown into contact with an overheated plate, either by a motion of the vessel or from a portion of the incrustation formed on the bottom or sides becoming loosened. A sudden opening of the safety valve may, under certain circumstances, prove dangerous, or even any rapid increase of heat which would cause a violent excess of ebullition in the water.

An examination is then entered into of the respective powers of water and of steam, to transmit undulatory motion, and of their compressibility. According to Laplace, the conducting power of steam at our atmosphere and 294·1° Far. is 1041·34511 feet per second, and that of water 6036·88 feet. The ratio of these different velocities is therefore as 1 : 4·5.

In cases of a sudden explosive development of steam, the principal action is directed against the bottom or the sides of the boiler, whence, spreading itself through the water, it is finally transmitted through the steam to the safety valve; a wave created by an explosion, even at the surface of the water, would reach the bottom or the sides of the boiler, $1\frac{1}{2}$ times sooner than it would affect the top of the steam chamber; but if it took place at the bottom, the time for the explosive wave to reach the safety valve would be the sum instead of the difference of both velocities. Although these relative periods of time may be considered as infinitely small, it is contended that there is sufficient delay (counting from the moment at which the plates begin to yield) to cause the rupture of the material which would otherwise have yielded by its own elasticity had the time been greater, as all communication of motion is dependant only on time.

Experiments upon Wires.—To illustrate the effect of the sudden development of an explosive force upon the plates of a boiler, the author gives the results of a series of experiments made by him upon iron wires, for the purpose of ascertaining the amount of elongation which took place before yielding under the sudden application of a given weight. The result was, that a wire which had resisted a tension of 22 cwt. when gradually applied, broke invariably, without any elongation, when the same force was suddenly applied by a falling body.

Upon Railway Bars of different qualities.—Similar experiments with railway bars showed that fibrous iron, which supported a gradual tension, broke by the sudden application of the same force; while close-grained iron, which was incapable of resisting the gradual strain, bore perfectly well that of sudden impact. These facts are worthy of consideration in the selection of iron for boiler plates, where the sudden action of the rending force is to be guarded against.

The details are then given of a series of experiments, illustrating in an ingenious model, by means of an explosive mixture of chlorate of potassa, the effects of explosions at different heights within a boiler.

Proposed Safety-valve.—A careful examination of the circumstances, and the results of his experiments, convinced the author that a simple mechanical arrangement, applicable to all boilers, might be introduced, so as to diminish the danger arising from the sudden development of an explosive force. He proposes to connect with the bottom of the boiler, by means of a pipe, an extra safety valve of a given area, loaded to five-sixths of the absolute cohesive force of the boiler plate. In the event of a sudden development of steam, the first shock would act upon the valve and open it, which would have the effect of depriving the wave generated of its destructive force, and at the same time diminish the violence of the second shock from the top of the boiler, having permitted the escape of a portion of the water from the boiler.

The apparatus for conducting the experiments was presented with the communication.

Steam Boiler explosions.—Mr. Parkes stated, that he had been occupied for several years in collecting facts illustrative of the phenomena of steam boiler explosions. These disasters could not all be referred to one cause. A boiler might be too weak to sustain the pressure within it, and a rupture would be the necessary consequence. But though the simple elastic force of the steam might thus occasionally account for the rending of a boiler, that cause was insufficient to explain many well-known phenomena, such as the projection of an entire boiler from its seat, the separation of a boiler into two parts, the one remaining quiescent, the other being driven to a great distance, &c. He was of opinion that a very sudden development of force could alone have produced such effects.

Dr. Schafhaeutl had ingeniously shown that an explosive force generated under water would act upon the bottom of the boiler and burst it, before the

* See the author's experiments, Mechanics' Mag., Vol. XXX. p. 144.

safety valve could relieve the pressure. The Doctor deduced from Mr. Parkes's theory of "the percussive action of steam," and his own experiments, that if, from any cause, such as the breaking up of a portion of crust adhering to the bottom of the boiler, a volume of steam of high elastic force was suddenly evolved, a rupture of the bottom would be the consequence, or, the boiler might be separated into two parts. Mr. Parkes coincided in this opinion, and cited several examples in support of it.

It appeared to him that a force different from, and greater than, the simple pressure of the steam, was the principal agent. The Committee of the Franklin Institute, and others, who in their experiments had endeavoured to produce explosions of boilers, had very rarely succeeded, and the effects obtained fell far short of those which continually occurred by accident. It might be safely inferred from this fact, that the experimenters had not arrived at the true cause of the ruptures and projections of boilers, otherwise the production of similar effects would not have been difficult.

Salt Pans.—Describing the sudden development of a volume of steam, from highly heated plates, which no practicable number of safety valves could discharge quickly enough to save a boiler from destruction, he instanced the effects produced by the breaking up of the scale in salt pans. Carbonate and sulphate of lime were separated from brine by evaporation, and adhered very firmly to heated surfaces. A crust of salt frequently formed upon this deposit; the cessation of ebullition (if the deposit occurred over the furnace) was the consequence, and the bottom of the pan became red hot. The manner in which the pan scale was disengaged, was to strike it with the edge of a heavy iron pricker, which allowed the brine to reach the plate; it was also frequently broken through by the expansion and bagging down of the plates, leaving the crust above like an arch. In such cases the plate was seen for an instant to be red hot, and immediately afterwards an immense column of brine was projected from the pan, the steam evidently being of high momentary elasticity. Mr. Parkes had seen a yard square of scale thus burst, the whole surface of the plate being at a glowing red heat. Had the pan been closed, like a steam boiler, he conceived that the blow of the steam on the roof, bottom, or sides, would have destroyed the vessel.

A thin copper salt pan at Mr. Parkes's works, had a hole burst through its bottom by the sudden action of steam thus generated. The spot had no doubt been previously injured by heat. He conceived that similar phenomena might, and frequently did, occur in steam boilers.

Heated Plates.—A theory has been adopted by many writers on the explosion of steam boilers, that red-hot iron plates would generate less steam than plates at a less heat. This was founded on the experiments of Leidenfrost, Klaproth, and others, on the length of time requisite to evaporate a small globule of water in a red-hot spoon. But there was no analogy between the condition of a hot spoon containing a drop of water, and that of a body of water and heated plates in boilers.

Steam of great force would instantly be produced from a thin sheet or wave of water, passing over hot plates, the molecular attraction of a drop falling a short distance upon a plate would be destroyed, and the whole be instantly converted into steam of a high momentary elasticity. The theory of the hot spoon experiment, as applied to boilers, had been demonstrated to be fallacious by Dr. Schafhaeutl in a paper published in the *Mech. Mag.* vol. xxx. No. 799.

"Union" Steamer at Hull.—The explosion of several boilers had been attributed, and Mr. Parkes thought justly, to a wave of water washing over highly heated plates. He believed that the fatal accident to the "Union" steamer at Hull was so produced. The boilers of steam vessels were not at that period so well arranged as at present, for preventing the water from flowing to one side, and leaving a portion of the top of the flues dry with the fire beneath. Under such circumstances, the disaster which occurred would be inevitable, on the vessel's coming on an even keel. Mr. Parkes was not of opinion that it required the exposure of a large area of heated metal to effect the separation of a boiler and the projection of the upper half of it; as, in this case, it was the suddenness of the action, no number of safety valves could have deprived the steam of its instantaneous force, so as to have saved the boiler. The entire circumference of large boilers had been frequently divided as clean as a pair of shears would have accomplished the work. These phenomena were evidences of a force very suddenly exerted.

Sudden actions on the surfaces of boilers arose also from other causes than the heating of plates. During the inquiry into the causes of steam vessel accidents, he ascertained that of twenty-three explosions, nineteen occurred on the instant of starting the engines, or whilst the vessels were stationary; three only whilst the engines were at work: the greatest number took place at the moment of admitting the steam upon the piston. He attributed this effect to the steam's percussive force, which would be as much felt by the boiler as by the piston: if the boiler was weak, and, distended by steam to nearly the bursting point, the shock would be sufficient to cause its rupture. Mr. Parkes then gave several instances of such occurrences.

Steam Vessel explosion at Norwich.—In 1817, the boiler of a steam vessel at Norwich burst, and killed many persons. Previous to the accident, the boiler leaked in several places; the steam issued copiously from the safety valve, which was evidently very heavily loaded. The engine had scarcely made a revolution before the explosion occurred. By applying the present state of our knowledge to these facts, he felt assured that the steam's impact on the piston had been the immediate cause of that accident.

Explosion at Passy.—In 1826 or 1827, Mr. Parkes witnessed the effects of an explosion, a few minutes after its occurrence, in the neighbourhood of his works, near Paris. The boiler was of wrought iron, 6 feet long by about 2 feet 6 inches or 3 feet diameter. By his advice the owner had previously put in a new end, formed of one piece of hammered iron, and he was strongly dissuaded from overloading his engine, or using habitually such enormous pressures. The cylinder of the engine was horizontal, and was connected with the boiler by a short pipe and cock. The proprietor informed him, that finding his machinery working too slowly, he went into the engine-house and stopped the engine. He held down the lever of the safety valve, and on turning the cock to start the engine, the explosion instantly occurred. The new end of the boiler, which was opposite to the engine, was found separated from the body, and lying in the flue. The line of rivets and a complete ring of the new end remained upon the body, apparently little forced, and the faces of the fractured ends were as sharp and clean as if cut by a chisel or shears. The boiler, engine, and masonry, were driven into the yard in the opposite direction to the escape of the water and steam; thus, though the entire end of the boiler was removed, and the whole contents evacuated, it acted too late as a safety valve.

Explosion at Camden Town.—He observed similar effects last year in an explosion at Camden Town, being fortunately on the ground to investigate it before much change had been made. Two boilers were set end to end with a chimney between them. The end of one was blown out, and was lying close to its original seat. It was forced backwards into the chimney, which it partly supported on a pipe flange, and pushed the other boiler and entire masonry in a horizontal direction fully two feet. He considered that the percussion of the steam from its re-action against the opposite ends of the boiler in the act of tearing it off (which was the effect in this case) produced the recoil. In this case there were upon the boilers (which were connected together) two safety valves in good order, and not heavily loaded. The accident occurred during the breakfast hour, whilst the engines were not at work. One of the two stays which originally held the fractured end of the boiler, was found to have been previously broken, as its separated ends were covered with old lime scale—the other had evidently been long cracked, and was only held by a fragment. The fractured end of the boiler was not exposed to the fire, nor did the shell or the flue within it exhibit any marks of injury from fire or from dislodgment of scale. The steam, in its effort to escape, acting first against one end, not only raised the boiler from its horizontal position to an angle of about 15°, but gave it a twist obliquely from the line of its bed.

High and low pressure.—Mr. Parkes could not agree in the often expressed opinion, that what are called high-pressure steam boilers were more dangerous or more liable to explode than others. Much depended on care and management. He believed that he was in possession of accounts of nearly all the explosions which had occurred in Cornwall since the expiration of Mr. Watt's patent, when higher pressures began to be used, and they amounted only to five or six instances, exclusive of some cases of collapsed flues. More explosions had occurred in a small district round Wednesbury during the present year with low pressure boilers, than in Cornwall in forty years, where the highest pressures were employed. He believed also that the coal districts of Northumberland, Durham, and Staffordshire, would furnish more cases of these disasters from boilers both of high and low pressure, than all the rest of England put together.

The coal districts.—When the practice in the coal districts was contrasted with that of Cornwall, the explanation was simple. Where coal was so cheap, the quantity used was unlimited, the negligence was great, and the allowance of boiler was small for any given sized engine, as enough steam could be raised by fires of greater intensity—the rule there being, to save in the first cost of the boiler; in Cornwall, on the contrary, the object was to insure economy in the consumption of fuel; consequently, all that class of accidents arising from injury to plates by fire and deposit, would be in about the ratio of the intensity of the combustion.

Notwithstanding the bad practice generally prevailing in the coal districts, there were some exceptions. At an iron work near Dudley, there were boilers now in good order after nearly thirty years' use, having required but trifling repairs during that period. In those boilers the plates of the bottoms which were exposed to the fire were all made of hammered, not of rolled iron—the boilers were large for their work, and were cleaned thoroughly every week.

Hammered plates.—Tilted plates were alone used for salt pans in those parts where the heat was most intense. Though continually heated to redness, and distorted by the action of the fire, the quality of the iron in plates thus formed did not appear to be deteriorated, for when taken out the smiths used them for making rivets, nails, &c. Rolled iron plates would do for making coarse salt, which required a heat below ebullition, but they were quickly injured when used for fine salt, and were useless when taken out.

Explosion at Essonne.—Mr. Parkes then adverted to several other remarkable cases of explosion. It was a well authenticated fact, that a boiler belonging to Messrs. Ferey, at Essonne in France, exploded on the instant of opening the safety valve.

Explosion at Lyons.—Three successive reports were heard when Steele's steam boat boilers exploded at Lyons, indicating that they did not burst at the same instant. Now, though Mr. Steele had fastened down the safety valve to increase the pressure of the steam, yet the explosion of the first boiler should, according to the received opinions, have acted as a safety valve to the second and third, and have saved them—for, by the destruction of the first boiler, the pipes would be broken, and a free exit be afforded for the steam in the others; nevertheless, they all three burst in succession. Several similar instances of successive explosions had occurred in England. He would not at present enter upon an explanation of what he considered might have occasioned these phenomena, but he would express his conviction that the practice of suddenly opening and closing the safety valves was extremely dangerous. To be useful as escape valves, they should be allowed to open and to close in obedience to the steam's pressure only, not to be handled more than was absolutely necessary.

None of the theories yet advanced appeared clearly explanatory of the cause of the projection of heavy boilers from their seats, when in many cases they contained abundance of water. He instanced a case in which a boiler exploded, and carried to some distance a boiler connected with it, and in which some men were at work. The boilers separated while in the air, and the one which exploded attained a very considerable height, although it was 28 feet long by 6 feet diameter. The particulars of this explosion were furnished to him by Mr. Clarke, engineer to the Earl of Durham, but they could not be properly appreciated or explained without the drawings and description.

Explosion at Durham.—A boiler weighing about 2½ tons was projected from its seat at Messrs. Henderson's Woollen Factory at Durham, in 1835; it ascended to a considerable height, and fell 300 yards from the place where it had been seated.

Crenver Mine.—A cylindrical boiler exploded at the Crenver Mine in Cornwall in 1812. It passed through the boiler house, and opened itself in the yard outside, where it was described to have fallen "as flat as a piece of paper."

Facts of this nature were replete with interest, and should lead engineers to the consideration of causes and remedies.

Boilers red hot.—Mr. Parkes then instanced several cases of boilers which had become red hot, and had not exploded; one example was a set of three boilers, the tops as well as the bottoms of which were red hot, in consequence of the house in which they were fixed being on fire; yet they did not explode. No water had, however, been pumped into the boilers whilst so heated.

Explosions of hydrogen gas.—He was in possession also of several curious examples of ruptures and projections of vessels arising from causes very different to the foregoing. One case occurred in February 1837, at the Works of Messrs. Samuel Stocks and Son, in the Township of Heaton Norris, near Manchester. The boiler was 20 feet long, 9 feet wide, and 10 feet deep, and weighed about 8 tons. On a Saturday night the water was blown out of it through the plug-hole at the bottom, by the pressure of the steam, the man-lid not being removed. On Sunday evening the fireman proceeded to take off the man-hole cover to clean the boiler; on entering it with a candle and lanthorn, a violent explosion occurred; and the man was projected to some distance and killed. On examining the boiler it was found quite dry, no fire being alight, no traces of water near it, and it was quite cold: it had been lifted from its seat up to the roof, which it destroyed, and the walls of the building were thrown down. There was no difficulty in accounting for the presence of a combustible gas, as hydrogen might be evolved from the decomposition of the steam (which would remain in the boiler after the expulsion of the water) by the heated sides and bed of the boiler, and the atmospheric air which entered through the plug-hole or through the man-hole, when the lid was removed, was sufficient to form an explosive mixture. The projection of the man was the simple effect of firing the gas; but to account for the entire boiler being carried from its seat, was more difficult. The figure of the boiler after explosion exhibited two distinct actions; the ends and sides had evidently been bulged outwards by the force of the explosion within it, and the bottom had been crushed upwards by the force which raised it from its seat.

Mr. Parkes thought the circumstances admitted of a satisfactory explanation, but would not then enter upon it, as it involved the history and phenomena of projections of vessels from their beds with a vacuum within them, which he thought would be better understood after the reading of his paper on the "Percussive Force of Steam and other Aeriform Fluids," then in preparation for the Institution.

The foregoing case of the formation of hydrogen gas in a boiler, after all the water had been evacuated, was confirmed by one which took place in a similar manner at the Sugar-house of Messrs. Rhodes and Son, in London, of which all the particulars had been furnished to him by Mr. Henrickson, the manager. A man entering the boiler with a candle and lanthorn to clean it, was projected to a great height. No rupture of the boiler took place, as the quantity of hydrogen seemed to be comparatively small, and to be confined to the upper portion of the boiler, but a series of detonations occurred, like successive discharges of cannon.

These two remarkable instances showed the importance of attending to minute circumstances in the management of boilers. The practice of completely blowing out boilers whilst the flues were intensely heated, was evidently dangerous, nor should it be done without removing the man-hole cover.

Mr. Parkes felt that these notices of explosions were very imperfect without drawings, and reference to documentary evidence, but, as the subject had been brought before the Institution by Dr. Schafhaeutl, he hoped that they would be received as contributions to the stock of knowledge, and as illustrative of the precautions to be observed by attendants on steam engines.

Mr. Seaward was glad to find the idea of the explosions of boilers arising from the formation of hydrogen gas, so successfully combated by Dr. Schafhaeutl and Mr. Parkes. He perfectly agreed with the former in his opinion of the causes of the majority of explosions. In all that he had witnessed the effects of the lower parts of the boiler appeared to have suffered most.

He was at the Polgooth Mine immediately after the explosion there, when seventeen persons were killed. In that case, he was told that the boilers were moved a distance of 7 or 8 feet from their seats, before any detonation was heard.

At the Hurlam Mine (which Trevithick had undertaken to drain for a certain sum) an engine with a cylinder of 10 inches diameter was erected immediately over the shaft. Its power was not sufficient for the work required; the pressure of steam was therefore gradually increased as the depth became greater. At length the boiler, which was of an immense length, was observed to have a constant tremulous or sinuous motion at each stroke of the engine, and eventually it exploded.

Boilers in London.—It appeared that there were fewer explosions of boilers in London, in proportion to the number employed, than in any other district. One reason for this might be, that fuel being expensive, it was used economically, by maintaining a slow rate of combustion, and a regular supply of steam, avoiding the intense action of the fire, which, in the event of the engine standing still for a time, had a tendency to produce an explosion.

Mr. Parkes attributed the small number of explosions of boilers in the vessels on the Thames to the practice of allowing the steam to act upon the safety valve, instead of the engineer lifting it when the engine was stopped, as on board vessels in the north. The sudden closing of the valve had in many cases produced an explosion.

While on this subject, he felt it necessary to comment upon what he considered fallacious reasoning of Tredgold on the formation of hydrogen gas in boilers.* The passage he alluded to was couched thus:—"Hydrogen gas may be, and frequently is, formed in steam boilers through the water being in contact with a part of the boiler which is red hot; and it seems to be regularly produced during the formation of steam at very high temperatures." Dr. Schafhaeutl had shown, that the effect of water coming suddenly in contact with a part of the boiler which was red hot, was only to disengage instantaneously a large volume of steam of very high elasticity. Mr. Parkes contended, that an instance of the sudden production of hydrogen gas in a boiler under such circumstances was unknown, and he much doubted the possibility of such an occurrence. Again, allowing such an event to be possible, an explosive mixture of gases must be formed before the boiler could be destroyed; and this could not take place so long as a sufficiency of water was present, from which any considerable quantity of steam could be generated.

Mr. Donkin did not entirely agree as to the non-formation of hydrogen in boilers under peculiar circumstances. He conceived the explosions which occurred in iron founderies, on the contact of the melted metal with wet sand, to be analogous. He believed, that when water was thrown suddenly upon red-hot plates, decomposition did occur.

He had once examined a wagon-shaped boiler which had exploded; the top was thrown to some distance, and the bottom was depressed throughout its entire length. He believed, that by intense firing the water had been nearly all evaporated; the bottom had then become red hot, the pressure of the steam had forced the bottom downwards when weakened by the heat; the water on each side then suddenly flowed on to the heated part, and an explosion instantly occurred.

Mr. Seaward had known instances of the internal tube of a boiler being collapsed without any injury to the external part or body of the boiler. He had always ascribed such occurrences to a deficiency of water; but Dr. Schafhaeutl's explanation of the rapid transmission of force through the wave to the bottom would sufficiently account for the effects which had been observed.

Mr. Donkin believed, that in almost every case the unequal pressure upon the exterior of the tube, arising from its not being perfectly cylindrical, was the cause of its collapsing.

Mr. Field was inclined to attribute all the explosions which he had witnessed to simple pressure.

When steam, or a small quantity of water, was suddenly admitted into a dry heated vessel, hydrogen gas was readily formed. He had made several sets of apparatus for the purpose. A strong wrought-iron tube was heated, and, being filled loosely with fragments of iron-turnings, steam was introduced and the gas was rapidly evolved.

He agreed with Mr. Parkes in condemning, generally, the fallacy of the opinion of Tredgold, previously mentioned, as to the formation of hydrogen gas. Still, in a large boiler, almost dry, and of which a portion was red hot, he conceived, that on the admission of a small quantity of water, hydrogen gas might be evolved.

Elevation of boilers from their seats.—The President was unwilling that this conversation should terminate without endeavouring to explain the cause of the elevation of the boilers from their seats. In his opinion, this might be satisfactorily accounted for by the action of atmospheric pressure.

When an explosion took place in a boiler, a considerable body of highly elastic fluid was disengaged; a partial vacuum was thus created above the boiler, whilst the full pressure of the atmosphere was exerted beneath it. This would cause the boiler to rise from its seat, provided the atmospheric air did not at the same instant rush into it, in which case the bottom would be pressed downwards, and the upper part being torn asunder, as had been described, would then rise into the air with the elastic fluid.

* Tredgold on the Steam Engine, vol. i. p. 251. Edition by Woolhouse.

When it was considered that the superficial area of these boilers was about 60 square feet; that the pressure of the atmosphere was nearly 1 ton per square foot, and that the weight of the boilers was only 8 or 10 tons, it would be apparent that the cause was quite adequate to the effect, with a very partial vacuum or inequality of atmospheric pressure. The case was analogous to those in which light bodies were raised into the air by whirlwinds.

He referred also to two cases of an equally uncommon nature, which had lately come under his notice professionally, and which he considered to arise chiefly from inequality of atmospheric pressure.

The first occurred at the Plymouth Breakwater during the great storm in the month of February, 1838, when several of the largest granite blocks, weighing from 3 to 8 tons each, composing the surface or pavement of the breakwater, which, although squared and dove-tailed into the structure, and embedded in excellent cement to the extent of their whole depth, and thus forming a solid mass, were torn from their positions, and projected over the breakwater into the Sound. He attributed this to the hydrostatic pressure exerted beneath the stones, at the moment when the atmospheric pressure above had been disturbed by the masses of water suddenly and rapidly thrown upon the surface of the breakwater. Blocks of stone were thus often carried to a great distance, not so much by the waves lifting them, as by the vacuum created above them by the motion of the water, which exerted at the same time its full pressure from below.

The other case occurred during a storm in the year 1840, when the sea door of the Eddystone Lighthouse was forced outwards, and it strong iron bolts and hinges broken by the atmospheric pressure from within. In this instance he conceived that the sweep of the vast body of water in motion round the lighthouse had created a partial and momentary, though effectual, vacuum, and thus enabled the atmospheric pressure within the building to act upon the only yielding part of the structure.

Signals for Railways.

A letter was read from Mr. Edward Alfred Cowper, describing some experiments on the use of maroons as signals on railways.

The maroons are either small tin cases, or cartridges of brown paper, charged with from ½ oz. to 2 oz. of gunpowder, mingled with which are 4 of "Jones's Prometheans," which are small glass tubes, each containing a drop of sulphuric acid; the tubes are surrounded with chlorate (hyper-oxy-muriate) of potassa, and are each enveloped in a strip of paper.

In the event of an accident occurring, which renders it necessary to give notice that an approaching train should be stopped at a given point, two or more of these maroons are fastened upon the upper surface of the rail by the strips of lead attached to them. The wheels of the engine, in passing over them, crush the glass tubes of the "Prometheans," the sulphuric acid inflames the chlorate of potassa, and causes an explosion of the gunpowder, which is distinctly heard by the engine driver, who immediately shuts off the steam, and puts down the break.

Mr. C. H. Gregory had permitted several trials to be made with these maroons on the Croydon Railway.

An engine was driven at full speed with a number of empty wagons attached to it, and with the steam blowing off to create as much noise as possible, yet the explosion of even half a drachm of gunpowder was distinctly perceived: he considered the invention to be practically useful.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ELEVENTH MEETING, 1841.

Description of the existing and contemplated Railways and Machinery connected with the Granite Quarry on Dartmoor, and of the mode of working them. By William Johnson, Grosvenor Wharf, Westminster.

Dartmoor is an extensive granitic table-land occupying the heart of the county of Devon, and in which many of the rivers of this county originate. It is in length from north to south 22 miles, and in breadth from east to west 14 miles. The height of the table-land above the level of the sea is from 1000 to 1200 feet; but the surface is broken by numerous masses of rock, which run up to three, four, and five hundred feet above the ordinary level of the moor; these are ranged in short chains, or they rise in rifted blocks, or in insulated hillocks, which are distinguished as Tors, or provincially *Tors*.

The surface granite of Dartmoor, which is in detached blocks, in infinite quantity, had been employed in the neighbourhood for the ordinary purposes of building from time immemorial. Quarried granite from Dartmoor was first brought into the market about 1820 by the Haytor Granite Company. A stone tramway was constructed from the Haytor quarries on the south-eastern face of the moor to the Stover Canal, near Newton Bushel, a few miles above Teignmouth, the nearest available port at which stone could be shipped, and by this means Dartmoor granite came into the market at considerable advantage, especially as the quality of the stone is such as to enable it to compete with the best Aberdeenshire, and, for many purposes, the lightness of its tint aided by the fineness of its texture, and the almost unlimited size of the blocks in which it could be procured without defect secured it a preference. The western face of London bridge is mainly composed of granite from Dartmoor. Dartmoor granite has also been introduced into many of the public buildings in the metropolis; amongst others the New Post Office, the Goldsmith's Hall, Fishmonger's Hall and Buckingham Palace.

The establishment of the Plymouth and Dartmoor Railway, which was completed in the year 1825, directed attention to the fine granite on the western face of the moor, by affording ready means of transport to the port of Plymouth for stone from Foggintor and other points adjacent.

The length of the Plymouth and Darmoor Railway, from Prince-town to the Tide Docks, known as Sutton Pool, at Plymouth, is about 25 miles; though the distance from one terminus to the other, by the carriage road, is not more than 16 miles; whilst a right line, from point to point, does not exceed 13 miles in length, the greater length of the railway being occasioned by windings to save expensive works, and to obtain tolerably equable inclinations upon which the trains might run down freely and allow the empty or slightly laden waggons to be drawn back without much waste of power.

The whole rise of the railway from its toll-house in Plymouth to the Prince-town terminus, by the Prisons of War, is 1350 feet; which, upon the net distance of 24 miles between those points, gives a rise of 56·25 feet per mile, or a ratio of nearly 1 in 94. The road is almost entirely upon the surface, with occasional slight cutting and filling, and a short tunnel (30 chains in length) occurs within the fourth mile from Plymouth. The wagons or trucks used upon the line consist of a platform or bed, set upon two centres, on two under carriages, to adapt them to their work and to the excessively sharp curves and irregular surfaces that frequently occur upon the line. The power used in working the line is the gravitation of the load, assisted by horses, the return being by horses entirely. Three horses draw eight single wagons, or four double ones, with from 30 to 40 tons of granite down, and take the wagons back when empty. There are at present no planes upon the line having gear worked by fixed power, or as self-acting planes.

The quarry which affords this railway its principal occupation, is worked by the Haytor Granite Company. It is situated within a quarter of a mile of the main line of the railway, from which a branch is laid into the quarry, at two miles from Prince-town, the floor of the quarry being at a level of 48 feet above the turn-out, and 1260 feet above the level of the quay at Plymouth, from which the stone is shipped.

The quarry is on the side of the Mount known as Foggintor, at from 350 to 400 feet below the summit. A gullet was first driven in horizontally, until a face of rock 50 feet high was obtained, presenting a most beautiful section of stone, in beds or layers of from eight to ten feet thick. The gullet has since been carried forward from 110 to 120 yards, and extended laterally until the bed of the quarry presents a cleared horizontal surface of nearly 4000 square yards. The benching onwards and outwards of the upper layers exceeds 2600 square yards, and the highest bench is 80 feet above the rails on the floor of the quarry. A considerable further extent of surface, beyond and above this, is uncovered of earth, and, the crust being removed, a vertical section of the granite tor is exposed, of nearly 100 feet in height.

A single blast in this quarry has been known to separate and remove 3000 tons of stone, and single blocks have been sent out weighing 20 tons, computed to contain about 250 cubic feet.

From the lower benches, in the face of the quarry, the stone has been taken up by derricks, or moveable cranes, and placed by them in the usual manner upon trucks on the railways, laid on the floor of the quarry; whilst, from the topmost benches, the stone is delivered over the side of the hill, and skidded down an inclined plane to the masons' sheds, where the operations of converting and dressing are performed, and from whence the blocks are conveyed upon railway trucks to the place of shipment.

The existing facilities for working the quarries, are now in course of further extension, by the construction of strong timber stages or scaffolds, with travelling frames, and upon the frames powerful traversing crabs, avoiding thereby the excessive labour and delay of lifting by the ordinary means of derricks and cranes. These stages rest upon the floor of the quarry in front, and run in parallel lines of 36 feet in width onwards upon the benches according to their heights, and give the means of taking up the stone wherever the blocks may be thrown out in blasting upon the different benches, and placing them at once upon the trucks on the floor of the quarry, by which they are taken to the mason's sheds, so that the quarry is kept constantly clear, and the largest blocks of stone are moved out with the greatest possible ease. An arrangement is in progress for transferring the travelling frames, with the crabs upon them, from one line of scaffold to another, by which means power may be accumulated to almost any extent upon any one stage, to operate upon blocks of extraordinary size.

Foggintor granite is at present extensively used for all the purposes to which granite has been hitherto applied. It is superior to any other in this country for steps, plinths, string and blocking courses, ashlars, pedestals, obelisks, columns, cornices, and indeed for all the purposes of architecture, because of the freedom and comparative ease with which it can be worked, being alike capable of the finest arris and of the fairest face, whether moulded or plain: whilst the purity and evenness of its colour, and the fineness of its texture in the deep beds, give it advantages not possessed in an equal degree by the produce of any other quarry in Great Britain. Foggintor granite is moreover peculiarly fitted for the more massive works of the hydraulic architect or engineer, on account of the magnitude of the blocks in which it procurable. It is in great demand for the quoin, hinge, and heel stones dock and other lock gates, for altars in graving docks, as well as for floors and curbs of such massive constructions, and for bridge constructions in all their varieties. Indeed, notwithstanding the facilities with which the work in the quarry is performed, the extent and depth of face exposed, and the ease with which the blocks are got out of the quarry, and upon the railway, it has hitherto been found difficult to supply, with sufficient rapidity, the existing demand.

The works at the Government Yard at Devonport—those of the magnificent new graving dock now in course of construction at Woolwich—Tenby Beacon in Pembrokeshire—the Neale Memorial in the New Forest, Hants—and the Nelson Testimonial—the retaining walls of Trafalgar Square—and the new buildings of the Sun and Alliance Fire Offices, in London, are all supplied with granite from the Foggintor Quarry. Many private works in various parts of England are also supplied with granite from this quarry, and the terrace walls and their approaches in the great quadrangle of Christ Church, Oxford, are about to be restored with Foggintor granite. Indeed, the fine texture and tint of Dartmoor granite adapt it peculiarly for terraces and for the basements of buildings whose superstructure and other collateral works are of Portland stone, Bath stone, or any of the best English freestones.

An important feature in the quarry now under consideration is the great depth at which the beds already accessible lie below the surface, yielding therefrom stone of the greatest degree of compactness and strength with perfect equality of colour; whilst the horizontal disposition of the rock allows of the removal of stone of fair forms, and in blocks of the largest size. Blocks have been sent from the quarries on Dartmoor even to Scotland to supply works there with sizes which could not be procured in that country. Sir Francis Chantrey's bronze statue of King George the 4th, in Edinburgh, stands on a block of Haytor granite, and the statue of Watt, at Glasgow, by the same distinguished sculptor, is also placed on a block of granite from Dartmoor.

Mr. Rendel bore testimony to the excellence of the quality of the Dartmoor granite, and to its peculiar fitness for any kind of work. The material was extremely good, and of sufficient fineness to admit of the most delicate moulds being made for it. It cleaves freely; there is little waste, and pieces of stone of all sizes, from the smallest to the largest, can be readily obtained. He had, some time ago, taken the dimensions of a block, and found it to be 67 feet in length, 5 feet by 8 feet at one end, and 3 feet by 5 feet at the other end. If a great outlay were justified, this granite would be the cheapest stone that could be used. The President stated, that he had attempted, some years ago, to introduce this granite into the market by means of the canal, near Tavistock, and now that such facilities existed for its transport, he would direct public attention to the beautiful slabs, columns, vases, and forms into which the Aberdeen granite was worked, and express his hopes that before the British Association next met at Plymouth, there would be a large manufactory of these articles in Dartmoor granite. The beautiful porphyry of Cornwall might also be employed in a similar manner. He could mention a remarkable instance of the durability of the Dartmoor granite. A slab which had been used as a foot bridge from time immemorial had recently been removed, and on the face, which had been turned downwards, was a Roman inscription, showing it to be at least 2000 years old.—Mr. Eaton Hodgkinson, in reference to some questions which had been asked, respecting the strength of stone according to the position in which it was placed, stated that in all bodies of uniform texture the strength would be the same in whatever position they are placed, but in bodies that are laminated the case is very different. He observed a very pernicious practice to have prevailed in the construction of many of our buildings, namely, the placing the stone without any regard to the direction of its lamination. He had extended his experiments to a great variety of stone, and he found that cubes of granite when broken with the greatest care, break up at once into wedges. Some valuable experiments on the strength of granite were published in the Transactions of the Institution of Civil Engineers, but the mode in which the experiments had been conducted was not stated, and a distinction is drawn between the crushing and the breaking force; but he thought that if the experiments had been made by pressing the stone between two perfectly smooth plates a somewhat different result would have been found; the granite would have broken up at once without crushing, as was uniformly the case in his experiments. He thought it important to interpose a thin substance, as a sheet of paper, between the plate and the stone; the pressure by this means becomes more perfectly distributed. A remarkable connexion existed between the ratio of the forces of extension and compression, and the angles at which the wedges or masses would slide off when broken by pressure. If these forces were equal, the wedges would slide at an angle of 45°.—Prof. Moseley remarked that the experiments of Mr. E. Hodgkinson were peculiarly valuable, because he had not confined himself to cubes, but extended his experiments to other forms. A singular prejudice had existed in favour of cubes. The commissioners appointed to report on the stone for building the House of Commons, experimented simply on cubes, whereas rectangles would have been much better.

Dr. Lardner's *Report on Railway Constants* was read. Details of this paper were presented to the Association in the year 1839, and reported very fully in the *Journal*, vol. 2, page 383, but as the communication was then merely verbal, and the rules of the Association require a written report, the report was formally presented, and the reading led to a good deal of discussion, but no new facts were elicited.

"*Report of the Committee on Railway Constants.*" By Edward Woods.

In a preceding Report of the Committee (published in the 8th volume of the Transactions of the British Association), five various modes of ascertaining the resistance to the tractive power on railways were described, and their relative merits discussed, and a variety of experiments on one of these methods, viz., by observing the motion of a load down an incline, sufficiently steep to give accelerated motion, having been made, it appeared, that the resistance increased in a degree previously unsuspected in proportion as the speed of the train increased,—but in what ratio, was not then determined, owing to certain discrepancies due, principally, to the varying effect of the wind at the time of the experiments. The Committee have continued to conduct their experiments in a similar manner, repeating them with various sizes of trains, at various velocities, on the Sutton incline, of 1 in 89 on the Liverpool and Manchester Railway, and on the inclines of 1 in 177, 1 in 265, and 1 in 330 on the Grand Junction Railway.* The data ascertained and given in the Report are,—1, The co-efficient of gravity on the inclination of the plane. 2, The initial velocity of train at some determinate point on that plane. 3, The terminal velocity at some other determinate point on the same plane. 4, The time elapsed in traversing the space intervening between these two points. 5, The space intervening. 6, The force of gravitation. 7, The weight or mass of the train, exclusive of the wheels and axles. 8, The weight or mass of the train subject to the rolling motion, viz., the wheels and axles. 9, The radius of the wheels. 10, The distance from the centre of the wheel, to the centre of oscillation. If a body move down an inclined plane without resistance, its velocity at any given depth below the level of the point where its motion first commences, will be equal to the velocity it would have acquired by a free vertical descent through the same height. This standard velocity being compared with the observed velocity of a body moving down an incline, and meeting with resistance, the amount of that resistance can be assigned. This mode has been objected to, from the apparent inconsistencies in the results; but these may be readily explained; and the Report shows a remarkable correspondence in the motions of the same train, when permitted to descend the same plane from the same point, provided the atmosphere be perfectly calm. The usual formula is applicable to three cases of accelerated, uniform, and retarded motion; the co-efficient of gravity is greater than, equal to, and less than the co-efficient of resistance accordingly; and the requisite correction will be negative, zero, and positive, so that the co-efficient of resistance may be found in all cases. The method of determining this correction was set forth in the former Report. When the motion is uniform, the mean resistance for any particular velocity may be assigned; but when the motion is accelerated or retarded between the two points of observation, although the mean resistance may be known, it cannot be stated with accuracy, whether that mean resistance is due to the mean velocity, or to some other velocity intermediate between the limits of the initial and terminal velocities, because experience has not yet assigned the law of the corresponding increments of resistance and speed. The results which the tables of this Report present, are considered under the following heads: the determination of the friction; the additional resistance produced by increase of speed in trains of different sizes; the effect of modifying the form of the front or end of carriages, and of other changes in the external surface of the train. Three first-class carriages were allowed to descend the Sutton incline from rest four times in succession, a length of 2420 yards. It appears that the resistance diminishes until the train attains the speed of 7·58 miles per hour, after which it increases; at 4·32 miles per hour, the resistance was 6·07 lb. per ton; at 7·58 miles per hour, 5·6 lb. per ton. This remarkable and hitherto unobserved result is owing, probably, to the more perfect lubrication of the axles at the higher speed; a certain thickness or film of grease is formed between the brass step and the upper surface of the journal, and keeps the two surfaces more effectually apart; at the lower velocities, the pressure of the step upon the journal has a longer time to act in effecting the displacement of the fresh grease which has been supplied from the box, and the result is, a greater amount of friction. Eight second-class carriages were allowed to descend the Sutton incline; the friction was a minimum at 5·84 miles per hour. The following results may be deduced from the above-mentioned series of experiments. 1, The friction was least when the train was moving at the rate of about 6 miles per hour. 2, The total resistance was also least at the rate of about 6 miles per hour, notwithstanding the effect of the atmosphere at that speed. 3, The mean resistance of first-class carriages was never less than 5·6 lb. per ton; and of the second-class never less than 7·75 lb. per ton; 6 and 8 lb. per ton will represent very nearly the mean of the resistances; and these values are used in the subsequent part of the Report. The motion of these trains being observed at lower parts of the incline, where the velocities were greater than the preceding, the resistance to the train of three carriages was 8, 12, and 16 lb. per ton, at velocities of 22, 26, and 29, miles per hour respectively, and the resistance to the train of eight carriages was 11, 12, and 14½ lb. per ton, at the velocities of 20, 25, and 29 miles per hour. Trains of 4 and of 6 carriages were impelled to the summit of the incline, and, the engine being detached, commenced their descent at the rate of 33 and 26 miles per hour. They descended through the first half of the incline with a mean velocity of 34 and 29 miles per hour, and through the latter half, with a mean velocity of 37 and 33 miles per hour. Other series of ex-

* As Dr. Lardner's paper on "the Resistance of Air to Railway Trains," (read at Newcastle, and reported fully, with diagrams, Journal, vol. 2, p. 383, was founded on these experiments, the reader had better refer to it.

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pe[illegible] made on the Grand Junction inclines; and the result of the whole shows the existence of an opposing power, created at it were by the speed itself, far exceeding that hitherto suspected.

A train of eight carriages weighing 40½ tons was started down the Madely incline 1 in 177, at speeds varying from 23 to 26 miles per hour; the mean speed attained was 25½ miles per hour. The motion of the train became uniform, so that the coefficients of gravity and resistance were equal. The mean resistance of the train was 12½ lb. per ton. A train of four carriages was started down the incline at 40 miles per hour, half way down the plane the velocity was reduced to 30 miles per hour, and at the foot, it was only 25 miles per hour. Four other carriages were started at a velocity of 32·7 miles per hour, they were retarded to 22·7 miles per hour, and proceeded with this uniform velocity to the foot of the incline. The results obtained in these experiments with the trains of eight carriages are of great practical importance, this being the nearest approach to the average passenger trains. 30 miles per hour is a fair average speed, and the resistance at the speed is about 15 lb. per ton, or almost double the value of the friction only. The friction may be diminished by proper attention to the fittings and the perfect lubrication of the axles, but its reduction is of secondary importance in the economic working of passenger trains, which, from their high velocity, must necessarily bring into play large and independent sources of resistance. The resistance to trains at different speeds being ascertained, the Committee directed their attention to the effect of external configuration on the resistance. A pointed body, as a prow, was fixed successively to the front and end of a train, but the differences observed were extremely slight, and such only as would have occurred with the same experiment repeated twice over; the pointed figure, whether before or behind, exercised no appreciable influence on the rate of the train's motion, or on the resistance of which that motion is the index. Experiments were also instituted, to ascertain whether the carriages being sent with their square ends forward, instead of being preceded by an engine and tender, would affect the results, but here also there were no greater differences than might be expected in an experiment repeated twice over; and it may be fairly concluded, that the form of the front has no observable effect, and that whether the engine and tender be in front, or two carriages of equal weight, the resistance will be the same. The intermediate spaces between the carriages were closed in, by stretching strong canvas from carriage to carriage, thus converting the whole train into one unbroken mass. The results were in favour of the train without canvas, but the differences are extremely slight; it is certain that no additional resistance is occasioned by leaving open spaces between the carriages, confining the intervals to the dimensions allowed in practice.

The Committee having ascertained that the excess of resistance, after deducting friction, required for its estimation something besides the elements of the dimensions and form of frontage, and of continuity of surface, it becomes important to inquire, what is the element exerting so powerful an influence? Their former Report contains the results of experiments with wagons on the Madely incline loaded to six tons each, and furnished with boarded fronts and sides moveable at pleasure; the differences in the results attained, were then referred to the increased frontage alone. But the experiments detailed in the present Report having been made, it became probable that the increased resistance was in a great measure dependent on the general volume of air displaced; and the Committee recommend experiments to be directed, to ascertain the effect on the resistance of diminishing and increasing the bulk of trains, the weight remaining the same.

Experiments were also made with the view of determining the amount of moving power expended in working a line, and for this purpose, the character of the line, in respect of its inclines, the weight and bulk of the train, and the speed at which the load is required to be conveyed, must be considered. The first of these alone is constant, depending on the nature of the acclivities and declivities. As an abstract question of dynamics, the power expended (the resistances being supposed constant, whatever the speed) is the same for a train travelling between two points on the same level, whether the road be be level or undulating, a due allowance being made for the difference of distance traversed. On the level line of railway, the speed of travelling would be uniform, but on the undulating line it would vary. And the real question is, will the increased velocity on the declivities compensate for time lost on the acclivities? Will the average rate of speed over the whole line be different? In order to obtain some definite result on the point, it was determined to send a train from Liverpool to Birmingham and back, a distance of 190 miles. Great care was taken in conducting this experiment, and the results are tabulated in great detail; and the following remarkable inference may be drawn, that a train of 12 carriages drawn by the same engine can be conveyed over a railway whose gradients range within the specified limits, in the same time as it could over a perfectly level railway of the same length. In ordinary practice, an engine of the dimensions tried (the Hecla) would receive assistance up the Sutton, Whiston, and Warrington inclines (1 in 89, 96, and 89), but this was not the case in the experimental trip, and the train encountered acclivities and declivities not contemplated in the application of this theory. It may therefore be inferred that the opinion entertained was correct, or that trains whose weights bear an ascertainable relation to the nature of the inclines they have to traverse, may be made to traverse those inclines at an average speed equal to what the power of the engine can effect on a level, and that an ordinary train would travel over the Grand Junction Railway (the steeper inclines of 1 in 96 being excepted) in as short a time as if the line had been absolutely level.

Mr. Brunel remarked on the inapplicability of results obtained from trains running down inclines to the ordinary working of trains on railways. Many of the results given in the Report differ exceedingly from the results of his experience in the working of the Great Western Railway. The cause of this discrepancy arose from the manner in which the resistances were obtained. In the train of carriages running down an incline, each carriage is slightly pressed upon by the next behind, so that the whole train is in the condition of a train that is pushed; and it is well known that the resistance of a train pushed from behind is much greater than of the same train pulled from before, as the carriages are thrown out of square.—*Atheneum.*

"Remarks on the Connexion which exists between Improvements in Pitwork and the Duty of Steam-engines in Cornwall." By Mr. Enys.

After adverting to the admission of the truth of progressive increase of duty, it was shown that considerable changes have been made in the course of seventy years, in the methods by which water is lifted out of the mines in Cornwall; and that in comparing the duty of earlier periods, an allowance of the difference of the Imperial and Winchester bushel of coal ought to be made. The distinction between horse-power and duty, pointed out by Mr. Parkes, was alluded to; one excludes, the other includes, the friction of the pitwork; and the remarks attached to each in Lean's report, show the necessity of adverting to the different conditions of the pitwork, in an attempt to estimate with accuracy the relative merit of different engines separate from the pitwork. In an endeavour, some time ago, to trace the causes of the great variation of the duty, a small amount of expansion was observed in engines remarkable for a low duty, and the reasons assigned were, either weak pitwork—flat rods—heavy load per square inch on the piston, and old boilers—and often the joint action of the above causes. The strength of the pitwork, or of the boilers, in different cases, seems to become the limit of expansion in the engines. In reference to deficiency of water from pumps, in proportion to the calculated quantities, on which duty is founded, two causes have operated in inducing a strong belief that it is less than at any former period: 1. Greater attention to the pitwork by the managers of the mines, under whose care it is placed, to the exclusion of the engineers of the steam-engine by which it is worked; 2. The extended use of the plunger pump—the latter instantly showing the slightest defect of the packing, and allowing of an easy remedy: while the bucket pump, on the contrary, does not show the defects in the packing; and the operation of tightening it is attended with great difficulty, so much so, as often to cause the repairing to be delayed to the last moment that the pump will lift water. The first cause, though it has a tendency to decrease duty in proportion to improved water delivery, has in a still greater degree the tendency to reduce the friction of the pitwork on a given load: yet it is not easy to assign the exact values. On the whole, a reduction of total resistances probably occurs in shafts of equal depth. On the other hand, the great increased depth of many shafts obviously produces a greater proportional friction on a given load. Under these circumstances, it becomes the fairer method to select the duty of engines working the deepest shafts, for a comparison with the duty of the earlier periods, when engines were worked so differently as regards the steam. Mr. J. W. Henwood (Wheal Towan) estimates the deficiency of water delivery at 7 or 8 per cent.; Mr. T. Wicksteed (E. Holmbush) 10 per cent. water from three lifts measured and weighed: Mr. Enys (Eldon's engine, United Mines), 4 per cent., measured four strokes of the engine from one plunger lift. The absence of attention in earlier times can only be assumed from the known habits of the miner, and the absurd stories prevalent of particular instances of neglect. Another great, but almost inappreciable change, has occurred within the last ten or fifteen years, in the increase of weight in the rods for a given load; but the circumstance of the greater weight of such rods again allowed of the reciprocal action of a still greater amount of expansion in Watt's engines; and in the heavy pitwork, the accumulated force stored up at the commencement was restored at the end of the stroke; the only loss in duty arises from an increase of the friction of the necessary balance weight; because, while a direct gain is obvious, the same mean power, by a greater amount of expansion, is obtained from a smaller quantity of water expended as steam. The present form of rod, with lifts alternately, where the shaft admits of this method, was probably due to Wat, or Murdoch. Smeaton, at the Chacewater Atmospheric Engine, in 1775t seems to have effected the introduction of one rod for a portion of the shaft, and dispensed with the older practice of tying up to the arch of the beam a separate rod for each lift. The plunger pump seems to have effected another change of some importance, in the velocity with which the larger portion of water is raised. The engines are usually made to go, out of doors, at rather more than half the velocity of the in-door stroke, the piston moving in-door, from 240 to 260 feet, and out of doors from 14t to 156 feet per minute; the velocity of the plunger, or bucket, is usually four-fifths of these amounts, or 110 to 120 feet per minute. Still a portion of the water, from one-third to one-sixth, is raised at three-fourths of the higher velocity; and recently larger valves have been placed below the plunger than above, with a view of equalizing the resistance of the water on passing the valves. A few experiments of trying an engine in-doors at a very low velocity have been made, which may perhaps be extended, to determine the increase of pressure due to different velocities of water in the pumps. The column of mercury, however, only becomes the measure of the total resistances of all kinds, which are subsequently, as far as practicable, to be separated, and values assigned to each as nearly as our means of observation admit. In commencing motion, after the state of rest to which pumping engines are brought, it is possible a greater power may be employed than is required to continue it. Still the term variable load, formerly adopted by the writer of this paper, may be too strong, and the rapid action of the mercury may render it inappreciable. In an attempt to value friction by the area of the rubbing surfaces of the packing of the plungers, it appeared the unanimous opinion of many of the best pitmen, that water could be kept from escaping with less friction by means of twelve-inch packing than with nine inch packing, in a twelve inch plunger-lift—a circumstance that requires attention, not only in this, but probably under numerous other conditions. In regard to the effect of expansion on the pitwork, in producing a variable strain during the load, it was observed, that with twelve times expansion on an engine recently erected, of Watt's construction, including clearance steam, the variation was as 8 to 1 at the end of the stroke; but that in a new engine of combined cylinder, by Sims, in which the expansion after three times in a smaller cylinder indoors, was increased about four times out of doors into a larger cylinder, and which power was converted in-doors into a constant quantity by means of a balance, the variation would be about as 2 to 1; and in Hornblower's or Woolf's, if worked with high steam, that under the condition of twelve times expansion, including clearance steam, the variation might be roughly taken as 3 to 1—that the commercial part of the question of more or less expense in engines or pitwork, would determine the relative advantages, on the whole, of each engine for lifting water from deep mines. It seems that expansion has not been carried out to so great an extent when the load is near the end of the beam, and when the enormous balance weights, usual in Cornish pitwork, are not required to be applied, though it is obvious that this condition causes less pitwork friction.—*Ibid.*

KING'S COLLEGE.

By a prospectus that has reached us of the business of the ensuing session, we perceive that, in accordance with the intimation given in our last number, the department hitherto known at this college as that of "Civil Engineering, and of Science applied to the Arts and Manufacture," is now designated the department of "Engineering, Architecture, Arts and Manufactures."

The course of instruction proposed for students in architecture is as full and satisfactory as that for engineers has been found to be. It extends over three years, and is as follows: "Mathematics; the principles of Mechanics, Hydrostatics and Acoustics: the theory of Construction; the elements of Chemistry; Mineralogy; Geology; the principles of Experimental Philosophy; Geometrical and Perspective, Ornament and Landscape Drawing; Land Surveying; Machinery; the principles and practice of Architecture, including Design and Composition, Construction and Architectural or Building Surveying."

Mr. Hosking has been appointed to the Professorship of the Principles and Practice of Architecture, in addition to his former duties, and he is to be assisted by Mr. Andrew Moseley, a younger brother of the County Surveyor of Middlesex, and of the eminent Professor of Natural Philosophy in the same College. The drawing of enrichments will be taught under the direction of Professor Dyce, of the Government School of Design, and Landscape Drawing by Mr. Cotman, who is well known as an artist, and for his work on the Picturesque Architecture of Normandy.

BITUMEN.

A new application of this material which promises to be of very great service in engineering works, has lately been successfully practised by the Parisian Bitumen Company. The new application consists in cementing large masses of rubble stone with the bitumen in a liquid state, and this has been successfully practised on a very extensive scale on the works of the Upper Medway Navigation Company in the following manner.

The river is divided into levels by weirs and locks in the usual manner. Some of those wiers are constructed at great expense of squared masonry; others are less expensively constructed, by throwing in the rubble stone of the country to the desired shape and height of the weir; it may be remarked that no care is taken in bedding the stones, or in laying them, which is performed by the ordinary labourers of the country. The bitumen is then melted and run in between the stones, and the whole forms a mass of such solidity as to resist the heaviest floods, and is perfectly impervious to water in every part, and it is supposed that it will not require one tenth of the repairs usually bestowed on weirs of the ordinary construction.

It may be noticed that previous to this material being used, the repairs after the winter floods, which are very heavy, were very great, and caused considerable interruption to the traffic.

The great advantages arising from using the bitumen in the manner described are cheapness and facility of construction—a very considerable reduction in the expence of repairs. It is evident that this may be used to very great advantage in foundations of bridges or large buildings, as forming a compact body capable of resisting any pressure, bearing any weight that may be imposed on it, and becoming perfectly solid in five minutes after being laid; it will effectually prevent vermin from getting into houses or burrowing near the foundations.

The manufacture of bitumen is now brought to great perfection by the same Company. Some beautiful specimens of tesselated pavement are being laid of different coloured bitumen, and floors of stations, churches, halls, &c., may be made very ornamental, and equally durable with Yorkshire stone, whilst it is much warmer to the feet and not more than half the price.

Presentation of a Piece of Plate to Mr. Storey, C.E.—A piece of plate value 350 guineas was lately presented to Thomas Storey, Esq., civil engineer, purchased by subscription and presented as a token of the respect entertained for that gentleman by the different parties connected with the great public works which have been completed under his superintendence. The plate was presented at the Fleece Inn, Darlington, after a sumptuous dinner to which 62 persons sat down. The service consisted of an epergne, elegantly and elaborately chased; a full-sized tureen; two do. sauce-do; four double vegetable dishes, with handles to remove, and to form eight dishes; two 12-inch salvers; four salt-cellars, gilt inside; four spoons do. to match; two gravy spoons; one fish slice; one soup ladle; two do. sauce. On the epergne, the tureen, and six other pieces, the following inscription, surmounted by Mr. Storey's crest, was beautifully engraved:—"This service of plate was presented to Thomas Storey, Esq. C.E., by a number of his friends, as a sincere though inadequate tribute of the esteem and regard they entertain for his professional talents, and private worth." Nicholas Wood, Esq., of Killingworth, C. E., presided, and John Harris, Esq. of Darlington, filled the vice-chair. In proposing Mr. Storey's health, the Chairman said—

"It has, however, been Mr. Storey's lot to extend his services beyond the immediate district. Of the great line of communication between England and Scotland—the great chain of communication—he has had the good fortune to execute a link; and I may add that it is a pretty long link. Now when I call to remembrance that it is 45 miles, I venture to say that this link will bear a comparison with any other link in the chain between London and Darlington (immense cheering). Gentlemen, I have heard only one opinion of that link; which is, that it is the smoothest and best piece of road between London and here (cheers). When I mention a "chain," I speak of the great lines of communication—the great public railways, and when I allude to the railway from Darlington, I do not refer to the various local lines which are more immediately connected with the transmission of coals; but I allude to the line between York and Darlington, which I think will bear comparison with any of the great lines that lie between this place and London (applause)."

Removal of the North Pier Light-house.—We have this week to record one of the most ingenious efforts of mechanical skill, which has ever been exhibited in the town of Sunderland. The enterprising engineer to the Commissioners of the River Wear, John Murray, Esq., who has already manifested so much ability in improving our harbour, and our noble piers, has long been engaged in erecting a new pier on the north side of the river, for the purpose of widening the entrance to the port, and this being now nearly completed, it has become necessary to remove the lighthouse from the old pier to the present splendid erection. To give our distant readers an idea of the difficulty, we may state that the height of the lighthouse is 68 feet, and its weight 280 tons. It was on Monday last, the 2nd inst., every thing having been prepared for the attempt, that Mr. Murray carried the first part of his design into execution, and actually succeeded in moving the ponderous mass 20 feet 5 inches to the northwards. The means by which this was accomplished will seem very simple when explained to our readers; but in reality great ingenuity was requisite in overcoming difficulties, which, to many persons, seemed to present obstacles altogether insuperable. Five principal pulling screws were strongly fixed to the glacis in front of the building, and were attached to chains fastened to the cradle upon which the lighthouse stands. These screws were worked by 24 men. In addition to these, there were four screws behind the cradle to assist in propelling it, which were worked by three men each; the total number of men employed on the occasion was forty. The cradle was supported on a great number of wheels, which travelled on eight parallel lines of rails, and the entrance end of the bracing was supported on slide balks. Operations were commenced at half-past three P.M., and at a few minutes after eight it was safely landed on the new pier, where it now stands, without the slightest accident having taken place. The building is now intended to be carried 150 yards to the eastward, or very nearly to the end of the New Pier, and for that purpose it will be blocked up in its present situation, until the railways and wheel timbers are reversed, which part of the work will occupy about a fortnight, when it is intended to resume the operations for its removal.—*Sunderland Advertiser, Aug. 6.*

LEGAL CONSTRUCTION OF RAILWAY ACTS AS TO BRIDGE BUILDING.

The Queen v. Walker and Another, and the Birmingham and Gloucester Railway Company.—(De Montpelier Street.)—This was an indictment against the Birmingham and Gloucester Railway Company for a nuisance. The bill was found at the January sessions, and having been removed into the Court of

Queen's Bench, by writ of *certiorari* obtained by the defendants, it came down to be tried on the civil side.

Mr. Serjeant Goulburn, Mr. Humfrey, and Mr. Daniel appeared for the prosecution; and Mr. Hill, Q.C., Mr. Clarke, and Mr. Spooner for the defendants.

It appeared that the company had erected a bridge for the purpose of carrying their railway over Montpelier Street, at Highgate, near Birmingham, which street it crossed nearly at right angles. The 16th section of the Company's Act of Parliament provides, "that where any bridge shall be erected by the said company for the purpose of carrying the said railway over or across any public carriage road the span of the arch of such bridge shall be formed, and shall at all times be, and be continued, of such width as to leave a clear and open space under every such arch of not less than 15 feet, and a height from the surface of the road to the centre of such arch of not less than 16 feet, and the descent under any such bridge shall not exceed one foot in 13 feet."

By the 48th section of the same act it is provided, that "whenever the said railway shall cross any public footpath not on a level, the said company shall raise or lower the said footpath so as to preserve an ascent or descent, as the case may require, of not more than one foot in 13 feet."

The span of the bridge in question over the carriage way was 16 feet, being one foot more than the span mentioned in the act, but about four feet less than the original width of the road. The company had at first intended to obtain the required height of 16 feet under the arch by lowering the surface of the road, but at the request (as was stated) of some of the neighbouring inhabitants, who apprehended inconvenience from such a declivity, they had only lowered the road about seven feet, leaving a headway of ten feet eight inches.

When, however, the bill of indictment had been found against them, they excavated the road about five feet more, but not, it appeared, sufficiently by about six inches to give the full height of 16 feet. This excavation rendered it necessary to build retaining walls of 96 yards in length to support the footpaths on each side of the carriage way, the thickness of these retaining walls being an encroachment on the original width of the carriage way till they reached the bridge. At first no provision had been made for the footpaths, but subsequently the piers of the bridge had been cut through, and the footways had been carried through them, descending under the railway by steps, and ascending in the same manner on the other side.

Mr. Serjeant Goulburn opened the case on behalf of Mr. Unett, the prosecutor, the proprietor of an estate in the neighbourhood, and contended that the company were bound to preserve the road of its original width, and had no right to contract it by means of their bridge: that the width of 15 feet mentioned in the act was a provision only applicable to cases where the road had been originally of no greater width, or of less width than 15 feet, and was the minimum, not the maximum width which the company were bound to leave; that the company were not justified in lowering the surface of the road, but ought to have obtained their height of 16 feet from the surface of the road to the centre of the arch, by taking the railway across the road at a higher level; that with respect to the retaining walls they were an encroachment upon the approach to the bridge, and were not justified by the act; and with respect to the footpaths the company had no right to contract their width where they were carried through the piers of the bridge, nor to carry them underneath the railway by means of steps.

Mr. Justice Parke, on the counsel for the prosecution calling Mr. Hornblower, architect and surveyor, of Birmingham, as the first witness, suggested that the case appeared to be a question of law upon the construction of the act of parliament, more than a question of fact, and enquired if the facts could not be agreed upon. It was ultimately arranged that Mr. Hornblower's examination should be proceeded with, as the shortest way of eliciting the facts, which were proved by him to the effect above stated.

Mr. Justice Parke then ruled:—1st. That the company were not bound to preserve the road of its former width, but had a right to contract it by means of the bridge, provided they left a width of not less than 15 feet.—2nd. That the company had a right to lower the surface of the road in order to obtain a height of 16 feet under the arch, and that they might lower the road either before or after they had built the bridge.—3rd. That the company had no right to contract the carriage way in its approach to the bridge by the retaining walls.—4th. That the company had not complied with their act by carrying the footpaths under the railway by means of steps; but as this plan appeared the most convenient to the public, and as the sloping of the footpath, in lieu of steps, would render it necessary to underbuild the houses, the court would not compel the company to alter the footpaths.

At the suggestion of the judge, and by the consent of the parties, a verdict was entered for the crown, the company entering into a rule to widen the carriage way by pulling down the retaining walls, and throwing them back into the footpath, and undertaking to lower the road still further, so as to leave a height of 16 feet clear from the surface of the road to the girders of the bridge.

The costs to be taxed by Mr. Hilditch.

The Queen v. Same.—This was an indictment for a similar nuisance in Highgate Place.—A like verdict was taken.—*Midland Counties Herald.*

ST. GEORGE'S CHAPEL, WINDSOR.

August 2.

For some years past the grand western window of this edifice has been considered to be in an extremely dangerous position, and very far from secure, in consequence of its bulging considerably inwards in many of its parts to the extent of several inches.

About 10 or 12 years since, the late Sir Jeffry Wyatville minutely examined the stone work of the window, and in consequence of his report it was determined it should undergo the necessary repairs under Sir Jeffry's superintendence: but, in consequence of the architect's then engagements, the repairs were not proceeded with.

The Dean and Canons, however, have just decided that the massive stone work shall be taken down, and the whole window entirely rebuilt, preserving the valuable stained glass it contains for replacement. The execution of this work, which will require the greatest care, so as not to injure some of the finest specimens of painted glass in the kingdom, has been intrusted to Mr. Blore, the architect, by the Dean and Canons.

The great painted window, over the altar, representing the Resurrection of our Saviour, divided into three compartments, designed by the late Benjamin West, and executed by Messrs. Jarvis and Forest, in 1788, has hitherto been seen to great advantage, in consequence of the three windows on the north and south sides of the west-end of the choir having been darkened (to give greater effect to the design), and painted over with the arms of the Sovereign and Knights Companions of the Order of the Garter in 1782, 1799, 1805, and 1812. The arms of each knight are encompassed with the Star and Garter, and surmounted with his crest and coronet. The George is beneath, affixed to a blue riband, on which the Christian name and title are inscribed. These six windows are to be immediately taken out, and for the darkened glass there is to be substituted transparent painted glass (containing the arms of the Sovereign and the Knights, and other heraldic devices), thus giving an air of great lightness and elegance to this part of the chapel, although, at the same time, very materially diminishing the grandeur and effect of the large painted window over the altar.

One of the windows was completed on Saturday July 31, and judging of the effect which will be produced from this one only, the alteration decided upon by the Dean and Canons will greatly improve the general appearance of the interior of the chapel. It will only require the remainder of the windows of the choir, which are now plain, to be of stained glass, to render St. George's Chapel one of the most imposing and magnificent sacred edifices in the kingdom.

The painted glass for the six windows referred to has been executed by and under the superintendence of Willement.

Except on Sundays the chapel has been closed for several weeks past, in order that no delay may take place in the completion of the work.

The splendid organ, which is considered to be one of the finest instruments in England, has just undergone a thorough repair by Gray. The old keys, which were upwards of 50 years old, and completely worn through, have been replaced by new ones, and several additions have been made to the pipes.

As soon as the improvements now in progress are completed, it is the intention of the Dean and Canons that the whole of the interior of the chapel shall undergo a complete and thorough cleansing and repair. Nothing has been done to the chapel in these respects during the last half century.

THE RIVER CLYDE.

At a meeting of the River Trust held on Tuesday, 27th July last, Mr. James Hutchison called the attention of the Trust to a matter of the last importance, viz. the extent to which the river should be widened. In the Bill which had lately passed Parliament powers had been taken to widen the river vastly beyond its present breadth, but if these powers were acted upon to their full extent, the time occupied in the operations, and the vast increase which it would cause in the expense of dredging and maintaining the extended river at the proper depth would be such as to place the Trust in a most dangerous position; and Mr. Bald had given it as his opinion that it might be productive of ultimate ruin. Mr. Bald had, however, prepared a plan of the contemplated improvements, similar to those which had been approved of in 1836, and though this plan did not widen the river to the extent which they had power to widen it by the Act of Parliament, still it must be admitted by all that it would improve the river sufficiently to accommodate the most extensive trade which could be reasonably expected to belong in after years to the harbour of Glasgow.

Mr. Bald briefly addressed the Trust, in explanation of his plans. From his remarks we learn that the width of the river from the bottom of harbour (at which it is intended to commence operations,) down to Renfrew, varies at present from 165 to 190 feet. It was his intention, however, to increase this width to 300 feet at the bottom of the harbour; to 310 at the mouth of the Kelvin, and to 325 at Renfrew Ferry; and at the same time to "sweeten" the course, or, in other words, to remove angles and jutting points, and to make the line a straight one. If the Clyde were thus widened it would be sufficient for any increase of trade that would come to it. By not going beyond this proposed width, the channel would deepen itself, and of the progress of this deepening process, they had that day an example in the arrival in their harbour of a ship drawing 17 feet water; and he anticipated, that in a few years, if the large or extended plan were not adopted, that the depth would increase to from 18 to 20 feet. He considered the proposition to increase the width of the river to 400 feet, beginning immediately below the harbour, to be most unwise, and one which he would not advise, even though the Trust might possess the means to execute it. It would take 70 years to complete the operations according to this extended plan, and when once finished the expense of maintaining it would be absolutely ruinous.

To a question from Mr. Burns,

Mr. Bald replied, that it was a law recognised by all engineers that if the channel of a river were widened beyond the proportion of its depth, it became more shallow, from the slower motion of the current. If, on the other hand, it was narrowed beyond this proportion, it had a tendency to become deeper from the more rapid motion of the stream, particularly in land floods. He instanced three places in the river, the harbour being one of them, where deposits were continually taking place, from their being unusually wide.—Were it otherwise, this silt or deposit would be at once removed by the land flood to the sea.

Mr. James Hutchison explained, that at the time it was resolved to take powers to widen the river to a great extent by the last Bill, Mr. Walker, upon making out the plans, informed them that if the breadth of the river was at any time extended according to these plans, they must make up their minds to the maintaining of it by dredging being immense.

After a conversational discussion of some length, it was finally resolved that Mr. Bald's modified plans should be adopted, and, as we understood, that operations should be commenced immediately.—*Glasgow Argus.*

STEAM NAVIGATION.

The Iron War Steamer Phlegethon.—We perceive, by the Calcutta papers brought by the India mail, that this vessel, which was built by Mr. John Laird, of North Birkenhead, for the East India Company, has arrived at that port. She is about 500 tons measurement, armed with two 32-pounders and other small guns, and is exactly the same size and model as the former iron war steamer, the Nemesis. She was to sail for China about the middle of June, to join the expedition. It was reported in the Bombay papers, that two armed steamers, the Ariadne and Medusa, both built by Mr. Laird, carrying each two 26-pounders, would be ordered to China: they would make an effective flotilla of four powerful iron armed steamers attached to the expedition, and, from the services rendered by the Nemesis, are likely to prove a great acquisition. The following extract of a letter, dated Calcutta, June 5, gives an account of the Phlegethon:—"I am too full of business to write at length just now; but you will be delighted to hear we arrived at this place on the 22nd of last month, as sound in hull, boilers, and engines as when we left England. We have had some severe trials, and a large share of stormy bad weather. The Phlegethon, in bad weather, has surpassed my most sanguine expectations, and having gone over 17,157 miles without straining a rivet, will I consider quite carry out the principle that these sort of vessels can navigate in security between England and India."—*Liverpool Albion.*

The Steam Ship "Admiral."—In these days of steam triumphs, we have frequently had to record the achievements of mechanic art, as applied to steam-ships of leviathan dimensions, as well as of the consummate skill displayed in the performance and management, and we remember few that have possessed greater claim to public attention than the splendid steamer *Admiral* now running between Liverpool and Glasgow, the same line on which the *Achilles, Commodore, Actæon, City of Glasgow,* and *Princess Royal,* all splendid steamers, are employed. The *Admiral* is a vessel well worthy of her name and lineage, and, whether the size and beauty of the ship, her excellent accommodations, or the great power and perfection of her machinery be the object of admiration, it must be admitted, that in each of these departments, she has never been surpassed. The engines supplied to this vessel are of unusual power and beauty of construction, fitted up with expansion gear, and possessing all the latest improvements: they were produced at the Glasgow Vulcan Foundry, and are of 200 horse power. It is a matter of great interest to witness the cleanliness and order always observed in the engine-room, and the great care and attention of the engineers are particularly worthy of notice for skill and sobriety: neither is the grand desideratum to a landsman (roomy accommodation) to be forgotten. There are 107 sleeping berths, all of the most ample dimensions, a limited number of which are divided off into state apartments. The grand salo n, around which these state apartments are arranged, is a magnificent room, and unites extreme comfort with ornament; on either side of it tables are ranged with elegant seats of richly carved oak, uniform with the chase panelling and groined roof. The entire fittings are of the most costly description, and the cuisine is excellent and cheap. The range of the *Admiral's* deck is 220 feet, it is perfectly flush, and forms a beautiful and unbroken promenade. The *Admiral* is a vessel of the same class and under control of the same business management at Liverpool as the Halifax line of steamers, and the same system of speed, punctuality, and good order which has obtained an exalted reputation for the Atlantic steamers prevails here, and has met with equal success.—*Morning Herald.*

MISCELLANEA.

ELECTRO-MAGNETIC PRINTING

On Monday, 2nd ult., the first public exhibition of Mr. Bain's electro-magnetic printing-machine took place in the Lecture-room of the Royal Polytechnic Institution.

The apparatus consists of a dial-plate, inscribed with the alphabet and numerals, with a revolving hand, worked by ordinary clock-work. On the other side of the room stood the important portion of the invention—that which furnished in type the communication to be sent forth from the dial-plate already described. Between these two machines a connexion (capable of being extended in practice to any length) by means of wire conductors, communicating with two electro-magnets placed on a frame, and connected with a cylinder covered with paper, upon which the type was to leave its impression—an horizontal wheel, in which types to correspond with the letters and figures on the dial were fixed. This wheel was ingeniously brought in contact with an inking roller, and these three portions of the machine were all brought into motion horizontally.

The party directing the communication stands at the dial-plate first described, and fixes a peg under the letter desired to be communicated. The index or revolving hand performs its rotation until its progress is arrested by coming in contact with the peg. A small trigger is then pulled, the galvanic power is then brought to bear by the aid of the communicating wires upon the two electro-magnets, with their machinery on the second frame, and the letter thus communicated is printed upon the paper affixed to the cylinder.

The operations excited universal admiration, and the machine itself is well worthy the attention of the curious, for though at present it may fail as a speedy means of communicating information in print, still by the adoption of a code of signals (by which one letter or character might be construed to denote a sentence or describe a subject) the invention might be made extremely valuable in the times in which we live.

Electro-magnetic Exhibition.—A very interesting exhibition has been lately opened at No. 8, St. Andrew Square, Edinburgh. It consists of several working models of different machines, such as a turning-lathe, a printing-machine, a saw-mill, and a locomotive carriage, driven by the power of electro-magnetism. The inventor of these models is Mr. Robert Davidson, an ingenious mechanic from Aberdeen, who has been engaged upon them for the last four years, and who has succeeded in effecting several improvements in the application of electro-magnetism, which promise to be of great practical value. He is the first, we understand, who has employed the electro-magnetic power in producing motion, by simply suspending the magnetism without a change of poles. The mode employed by Jacobi, Davenport, and Storrar, consisted in keeping the repulsive power (which is equal to a third only of the attractive power) in operation during the one half of the time, and the attractive power during the other half. Mr. Davidson's discovery consists in a simple and extremely ingenious method of communicating and cutting off alternately the galvanic current to and from a pair of electro-magnets that always act attractively, so as to exert a constant moving force upon the machine which is put in action. It has received the approbation of numerous scientific gentlemen, who consider that Mr. Davidson has succeeded in showing the perfect applicability of magnetism as a motive power to engines of every description. It would no doubt be desirable, however, to see experiments tried on a larger scale; which Mr. Davidson, we understand, is anxious to do, but is deterred by the want of funds.—*Scotsman.*

Travelling by Electro-magnetic Power.—We are informed that a distance of 57 miles has been travelled on the common road, in a Bath chair, by electro-magnetic power, in one hour and a half; and further, that the applier comes over daily from St. Alban's to the Bank of England in the said chair in half an hour at an expense of sixpence. The model of an electro-magnetic engine, which has been exhibiting at the Adelaide Gallery for some time, is an instance of ingenious mechanic arrangement, whereby contact is broken and renewed, the poles reversed, &c.; and from its performances gave great promise of practical powers on a larger scale. The battery employed is the nitric acid, or Grove's battery. Of the invention that has done the great feat, and established the successful application of this wonderful agent, we know little more than its success. We hear that the increase of power is due to the discovery of a new combination of elements; that this is the secret of the moving power; and that the battery is to be the subject of a patent.—*Literary Gazette.*

Edinburgh and Glasgow Railway.—It is gratifying to observe the incessant exertions which are making everywhere on the line in the vicinity of this city to get this national undertaking completed. The magnificent entrance to our great tunnel is drawing to a conclusion, while the booking and other offices are all but finished. The landing and departing platforms are now getting very handsome sheds, with elegant cast iron supports set up; and the ground is clearing out for laying the permanent rails. Yesterday Mr. John Craig, the mineralogist, made a survey of the tunnel, in furtherance of the objects of the British Association, and proceeded right through it, in company with the very polite and spirited contractor, Mr. Marshall. Amongst many other geological specimens got in the journey, we saw perfect masses of the *Nucula Tumida, Producta Scotia, Producta Martinnii, Bellerophon Urii,* and *Apiocrinites,* imbedded in a shale, above a two feet limestone, with many other interesting remains of a period long before the creation of man.—*Glasgow Constitutional,* August 4.

London and Brighton Railway.—The Brighton terminus is now completed externally. All the works are on a magnificent scale: and the passengers' sheds and station vie with any works of a similar kind in the kingdom. The station is even larger than that at the London terminus of the Birmingham Railway in Euston-square; and the edifice forms a pleasing and prominent object from various parts of the town.—*Brighton Gazette.*

Bristol and Glocester Railway.—The works on this line are proceeding rapidly in the neighbourhood of Wickwar, where 600 additional labourers have been put on this week.—*Glocestershire Chronicle.*

Cheltenham and Great Western Union Railway.—Contracts have been taken, and in some instances the works have been commenced, for carrying on this line from its present terminus at Cirencester towards Stroud and Gloucester. —*Cheltenham Looker-on.*

Paris and Rouen Railway.—This great work is proceeding rapidly, under the superintendence of Mr. Locke; and we understand that thirty-five miles of the Paris end of the line will be opened early in the spring of next year.

Railroad from Berlin to Hamburgh on the right bank of the Elbe.—The *Hamburgh Gazette* under date Berlin, the 24th ult., announces that a commencement had been made in this affair. The provisional committee was appointed definitively, with power to adopt resolutions. This enterprise was calculated to consolidate the interests of so many people, that the most perfect accordance was necessary. The number of subscribers amounted to 5,000.

Railway Filters.—For some time a number of men have been employed in the erection of filters on the top of the terminus of the Greenwich Railway, for the purpose of supplying the engines with pure water, it having been discovered that the water that has been used has occasioned considerable injury and wear to the machinery. There are also similar filters erected at the New Cross station, on the Croydon line.

Iron Lighthouse.—The necessity for a lighthouse to facilitate the navigation of the windward passage by the Morant point, in the island of Jamaica, so as to enable vessels to avoid the Morant Cays, a dangerous reef of rocks, 25 miles south-east of that point, having been long felt by the authorities of the island, they have determined upon the erection of a tower and lights for that object, upon the recommendation and under the direction of their consulting engineer, Mr. Alexander Gordon; and it may now be seen in a very advanced state of forwardness, from the road at Pimlico, erecting on the works of Charles Robinson, proprietor of the long-known establishment of Bramah and Sons. It forms a most conspicuous and imposing object as it rears its head above the surrounding buildings; and when completed to its full height, 100 feet, will doubtless attract much notice from its novelty. The diameter of the base is 18½ feet, tapering gradually to 11 feet under the cap, which supports the lantern containing the lights and reflectors, which, with the actuating apparatus for revolving the lights, are constructing by Deville, of the Strand.

The Dry Rot.—Government have recently ordered the opening of the fungus pits in Woolwich dockyards, which had been closed in August, 1836, for the purpose of testing the virtues of Sir W. Barnett's process for rendering wood, cordage, and all descriptions of woollen free from the effects of dry rot. The result, it would appear from the reports of the officers deputed by the Admiralty to superintend the experiments, is in every way successful, the prepared wood being as clear and sound when it came out as when first deposited.—*Inventors' Advocate.*

Thames Tunnel.—The shaft of the Thames Tunnel on the Wapping side of the river, in which the circular staircase is to be formed for foot passengers, has now almost entirely disappeared, and not more than five feet of it appears above the ground. A month ago it was on a level with the tops of the adjoining houses, and its gradual sinking as the earth below is excavated has excited the surprise of the inhabitants. In depth it is 60 feet, and it will be raised 15 feet higher, and again sunk. Since the engineer of the Tunnel, Sir Isambard Brunel, and three other gentlemen, passed under the driftway connecting the shaft with the Tunnel, many others have passed from one shore to the other by the same means. The completion of this stupendous work is close at hand.

Asphalte.—For some time past the Seyssel Asphalte Company's men have been actively engaged on the New Junction line of the Greenwich Railway, in covering the arches, which when completed will extend over a space of 400,000 feet.

New Steamers.—On the 21st instant a fine steam vessel was launched from the building yard of W. Pitcher, at Northfleet. She is for the Sicilian Government, and named the "Maria Teresa," her tonnage is about 300, and the collective power of her engine will be 120 horses, manufactured by Messrs. Boulton, Watt & Co. of Soho. A second vessel for the same government is in considerable progress, of smaller dimension to carry two 50-horse engines, from the same establishment.

A Miniature Steamer called the "Fire Fly," has been astonishing the frequenters of the Thames by its rapid evolutions on the river, she is a moderate sized boat propelled by Ericsson's propeller fitted in the stern and driven by two oscillating engines, set *horizontally*, and at right angles the crank shaft. The diameter of the cylinder is only 3 inches, and 6-inch stroke, making 180 to 200 strokes per minute, worked with high pressure steam of 50 to 60 lb. on the square inch, generated by a very compact locomotive boiler. The engines and boiler were entirely constructed by Mr. Warriner, formerly a pupil of Messrs. Braithwaite, Milner and Co., the engines possess several improvements worth introducing in larger engines, particularly the method adopted of conveying the steam into the cylinders instead of through the gudgeons, upon which the cylinders oscillate. She steams about 8 to 9 miles per hour through the water, and has run with the tide from Blackwall to Westminster Bridge in 50 minutes.

Captain Ericsson is now in New York, and engaged by the American Government to construct two engines of 1,000 horse power collectively for a large sea-going vessel to be propelled by the Captain's propellers.

Galvano-plastic Casts.—A letter from Munich informs us that the celebrated Bavarian sculptor Stigelmayer has brought to such a pitch of perfection his galvano-plastic process, that its effects would be deemed fabulous were they not publicly exhibited in the Museum of the Society of Arts. In the space of two or three hours colossal statues in plaster are covered with a coat of copper, which takes with the greatest accuracy the most minute and delicate touches, giving the whole all the appearance and solidity of the finest casts in bronze. M. Stigelmayer has also applied his process to the smallest objects, as flowers, plants, and even insects, bringing them out with such accuracy, that they seem to have been executed by the hands of the most skilful artists.

Highest Chimney in the World.—The highest chimney in the world is at the soda ash manufactory of James Muspratt, Esq., near Liverpool. It is the enormous height of 406 feet above the ground, 45 feet diameter inside at the base, 9 feet ditto at the top, and contains nearly 4,000,000 of bricks.—*Daily paper.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 28TH JULY, TO 27TH AUGUST, 1841.

Six Months allowed for Enrolment.

JOSEPH RATCLIFFE, of Birmingham, manufacturer, for "*certain improvements in the construction and manufacture of hinges for hanging and closing doors.*" (A communication.)—Sealed August 4.

OWEN WILLIAMS, of Basing Lane, London, engineer, for "*improvements in propelling vessels.*"—August 4.

JOHN LEE, of Newcastle-upon-Tyne, manufacturing chemist, for "*improvements in the manufacture of chloride.*"—August 4.

JAMES WARREN, of Montague Terrace, Mile End Road, for "*an improved machine for making screws.*"—August 4.

STOFFORD THOMAS JONES, Tavistock-place, Russell Square, gentleman, for "*certain improvements in machinery for propelling by steam or other power.*"—August 4.

WILLIAM CRAIG, engineer, ROBERT JARVIE, rope-maker, and JAMES JARVIE, rope-maker, all of Glasgow, in the kingdom of Scotland, for "*certain improvements in machinery for preparing and spinning hemp, flax, wool, and other fibrous materials.*"—August 11.

SAMUEL BROWN, of Gravel-lane, Southwark, engineer, for "*improvements in the manufacture of metallic casks or vessels, and in tinning or zincing metal for such and other purposes.*"—August 11.

JOHN SEAWARD, and SAMUEL SEAWARD, of the Canal Iron Works, Poplar, engineers, for "*certain improvements in steam engines.*"—August 13.

WILLIAM HALE, engineer, and EDWARD DELL, merchant, both of Woolwich, for "*improvements in cases and Magazines for gun-powder.*"—August 13.

JOHN HARVIG, of the Strand, gentleman, and FELIX MOREAU, of Holywell-street, Millbank, sculptor, for "*a new and improved mode or process of cutting or working cork for various purposes.*"—August 21.

JOHN HARVIG, of the Strand, gentleman, and FELIX MOREAU of Holywell-street, Millbank, sculptor, for "*a new or improved process or processes for sculpturing, moulding, engraving, and polishing stone, metals, and other substances.*"—August 21.

JOHN THOMAS CARR, of the town and county of Newcastle-upon-Tyne, for "*improvements in steam engines.*" (A communication.)—August 21.

GEORGE HICKES, of Manchester, agent, for "*an improved machine for cleaning or freeing wool, and other fibrous materials, or furs and other extraneous substances.*"—August 21.

CHARLES DE BERGUE, of Broad-street, London, merchant, for "*improvements in axletrees and axletree boxes.*" (A communication.)—August 21.

FREDERICK DE MOLEYNS, of Cheltenham, gentleman, for "*certain improvements in the production or development of electricity, and the application of electricity for the obtainment of illumination and motion.*"—August 21.

WILLIAM WALKER JENKINS, of Gred, in the county of Worcester, manufacturer, for "*certain improvements in machines for the making of pins, and sticking the same into paper.*"—August 27.

EDMUND MOREWOOD, of Highgate, Middlesex, gentleman, for "*an improved mode of preserving iron and other metals from oxidation or rust.*" (A communication.)—August 27.

MILES BERRY, of Chancery-lane, civil engineer, for "*certain improvements in the means and apparatus for obtaining motive power, and rendering more effective the use of known agents of motion.*" (A communication.)—August 27.

SAMUEL HARDMAN, of Farnworth, near Lancaster, spindle and fly-maker, for "*certain improvements in machinery or apparatus for roving slubbing cotton and other fibrous substances.*"—August 27.

THOMAS CHAMBERS and FRANCIS MARK FRANKLIN, of Lawrence-lane, London, and CHARLES ROWLEY, of Birmingham, button manufacturer, for "*improvements in the manufacture of buttons and fastenings for wearing apparel.*"—August 27.

TO CORRESPONDENTS.

"G. Coe."—*On Reversing Engines; an accident occurred, as we were going to press, which damaged the engravings, we were therefore obliged to postpone the notice until next month.*

Severn Navigation.—*We have received a very valuable report by Mr. Fulljames, on the proposed improvements of the river, well deserving a perusal by all parties connected with this long contested "improvement."*

Mr. Brooks and Mr. Barrett.—*After a careful perusal of the communications from these two gentlemen, we have determined not to insert them, as we feel convinced that they will only lead to an endless altercation between both parties.*

We must request the favour of our correspondents, who may favour us with articles which require engravings to illustrate them, to let the drawings be separate from the manuscript, and drawn on thin paper—good tracing paper is the best, and if possible to draw them so that they shall come within the width of a column (3½ inches), or the width of a page (7 inches.)

Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume

ERRATA.

Page 319, *col.* 1, 18 *lines from the bottom, for* "quantity," *read* "pressure."
Page 319, *col.* 2, 23 *lines from the top, for* "our atmosphere," *read* "four atmospheres."

HISTORY OF DECORATIVE SCULPTURE IN FRANCE.

(Concluded from page 259.)

When the kings of the first race founded the French kingdom, they built churches, some of which are mentioned by Gregory of Tours (B. 2 § 14, 15, &c.), but which have all unfortunately been destroyed. Some remains of these primitive edifices are still however to be seen in marble capitals used in the churches rebuilt after the Norman ravages. Thus at Montmartre there are capitals of white marble, the style of which calls to mind degenerate antique forms, and which can only be assigned to the first ages of Christianity; this is evident from the Greek cross still to be seen on the volutes of one of them, the irregular management of the foliage, the inferior execution, and the sharp forms which made their appearance with Christianity, and did not leave until the Revival. These are features belonging to a period of art very nearly approaching the Lower Empire, but Christian notwithstanding as the emblems plainly show. At Jouarre, a place famous for its abbey, is still to be seen a subterranean chapel at the end of the cemetery, having, like the church of Montmartre, several capitals of white marble, which in the singular form of their leaves, and in the variety of their composition, since there are no two alike, show more of the classic character of antiquity, and on the contrary present all those which are proper to the first centuries of Christianity. The church of St. Denis has on several capitals *fleurons*, like those of Jouarre, and which might have formed part of the church of Dagobert. To the same period a Greek cross, found some years ago behind the apsis of the present church, appears to belong. The ruins of the Abbey of St. Medard, at Soissons, have among them a marble capital, in which may be recognized the degenerated traces of ancient art, and seeming to belong to some of the edifices of the kings of Soissons, who were buried at St. Medard.

Between this first period of modern civilization and the eleventh century, monuments are wanting to enable us to follow up step by step the history of the subject before us, a deficiency which must no doubt be attributed to the numerous invasions, which took place during the Carlovingian reigns. When the reign of the Capets commenced Robert the Pious rebuilt the churches, and art took a new direction, of which there is now abundant evidence. The church of St. Germain des Prés, at Paris, for instance, notwithstanding many details attributable to the barbarism of the age, has some fine parts, particularly around the choir. There, the capitals, composed of large leaves, contain chimerical animals, contributing to the effect of the composition, and the great variety which prevails is good proof of the rich and fertile imaginations of the medieval artists. At this period the leaves of the acanthus and the volutes, with other elements of ancient ornament, still formed part of decoration, but their general forms were entirely modified. The historical capitals of the nave of St. Germain are also of the eleventh century, and are not less interesting than those of the choir. (See Figs. 1 and 2.)

During this period of art, the capitals form two very distinct classes, 1st, of those in which, in imitation of the Pagans, Christian artists only imitated foliage as the basis of decoration; 2nd, capitals enriched with human or animal figures, and of which the origin is also to be found among the ancients. The first are evidently a consequence of the capitals of the first period of our era, of which we have mentioned that there are examples at Montmartre, St. Denis and Jouarre. In the eleventh century they exhibit an imitation more or less exact of the Corinthian column. The ornaments of the astragal of the capital in the church of St. Spire at Corbeil, and of Esnay at Lyons, are composed of water leaves, imitated from the antique, and executed badly enough. In the cloister of Moissac they are replaced by Byzantine rosettes. The foliage of this period presents acute forms, removing the artist from the study of nature, a direction which was given to art by the Orientals in the time of Justinian, and afterwards adopted in the west. Above the astragal is the capital, differing from that of the ancients as it takes every imaginable geometric figure, the details of the Corinthian foliage gradually disappearing and giving place to original compositions, sometimes not without harmony and taste. The subjoined capital from the church of St. Germain des Prés is an instance of this.

During the whole period, included between the last Carlovingians and the 13th century, the principal elements of ornamental sculpture are an imitation, more or less good, of the acanthus, their leaves edged with pearls, palms, scrolls, and other exotic types.

The second class of medieval capitals is distinguished from the first by heads of men and animals, chimeras, and sea or land monsters, mixed up with acute foliage imitated from the oriental flora, and which are afterwards succeeded by religious, historical, or symbolical subjects covering the whole surface of the capital to the exclusion of other

Fig. 1.

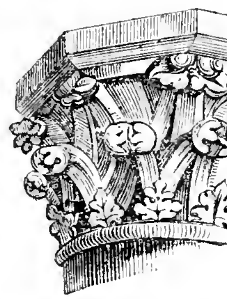
Fig. 2.

Capitals at the Church St. Germain des Pres.

ornament. This second system, like the first, owes its origin to antiquity. The Etruscans often mixed up the heads of men with foliage in their capitals;* the Romans introduced persons on foot, of which a fine example is to be found in St. Lawrence without the Walls. Without leaving France, ancient examples are to be found of this mode of decoration, as at Vienne in Dauphiny, where on a beautiful Corinthian marble capital of large proportion, are four heads of Pagan divinities. The Museum of the same city contains a fragment seemingly rather later, and in which are also figures and animals in the midst of foliage. A Medusa's head is in the middle, two serpents intertwined form the volutes, which rest on large acanthus leaves. The church of St. Germain des Prés shows the whole progress of the system, some of the capitals being covered with historical and religious subjects. (Vide Fig. 2.) The royal vault in the subterranean church of St. Denis, is decorated with purely historical capitals, representing kings of France, bishops removing relics, &c. (Vide Fig. 3.)

Fig. 3.

Fig. 4.



Capitals at the Church St. Denis.

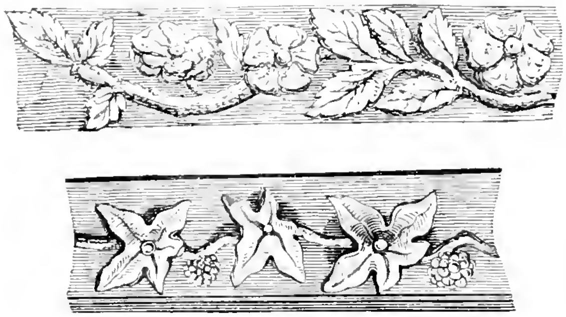
In the 12th century national art acquired a less barbarous tendency, and in St. Denis, we see in the parts built by the Abbot Suger, capitals of good character and scrollwork still more remarkable, forming the decoration of the pilasters of the north side door to the cemetery of the Valesians. At this period, more than in the preceding, painting was applied in aid of sculpture, and in the next century, it attained its complete development. Even in the 12th century the Christian artists, deprived of ancient models, sought for the elements of ornament in the national flora; and in the succeeding period the acanthus and all the exotic plants were wholly excluded from sculpture, and gave way to French flowers and foliage. The execution of ornament in the end of the 12th and 13th centuries is very good, for the sculptor, being perfectly acquainted with the forms he was to imitate, produced broad and noble compositions, in a style which, although severe, was completely in harmony with the buildings. In the 13th century Peter of Montereau, architect to St. Louis, one of the most skilful artists of his time, gave new vigour to the art of decoration; he introduced in the chapel of Our Lady in the church of St. Germain des Prés, and the Sainte Chapelle of the Palais, ornaments of remarkable precision and taste. Notre Dame, which has some parts of the same date, shows in the great capitals, supporting the columns of the nave, and in the details of the doors, how much the art of the scultpor was advanced,

* See an example in the British Museum.—Edit.

Fig. 5. Fig 6.

Capitals at the St. Chapelle, Paris.

Figs. 7 and 8.

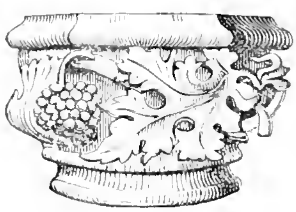


Ornaments from the Church Notre Dame, Paris.

The capitals of the Hotel de Dieu at Paris, of the Abbey of Poissy, of the front of St. Julian the Poor, &c., were so many masterpieces of the luxuriant imagination of the decorators of the 13th century. Among the examples of this period may also be classed the beautiful ironwork of the gates of Notre Dame; it is composed of scrollwork in the best taste and of the finest execution. The date of it is not decided; but it evidently belongs to the 13th century, agreeing in style with the ornament of the rest of the building. In the gate in the middle of the grand front the skilful artist has intermingled birds, winged dragons and foliage, with a statue of St. Marcel in the midst. This beautiful piece of ironwork is unique in Europe, and well deserving of the attention of artists on account of the elegant forms which have been given to the iron.

The ornament of the 14th century was of a character almost as high as that of the preceding, but the forms had already become less simple and less true, the capitals were divided into stages of foliage, the as-

Fig. 9.



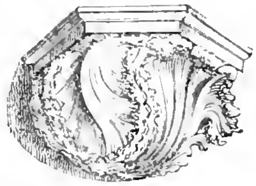
tragals assumed the obtuse angles of the polygon, and the foliage rolled upon itself, gives an appearance of confusion which destroys the general effect. The fleurons which decorate the finials and crocketings are formed of sharp and divided leaves, as thistles and holly, from which there results less severity of appearance in buildings of this age than in those of the foregoing.

In the 15th century great license prevailed in national art; the sculptors gave themselves up to the most vagabond inventions, representing climbing plants of a light form and divided foliage. The vine, thistle, and endive were the most frequent models adopted in buildings of this period, and the use denoted the approach of a revolution. The execution is free, and shows great facility, which they abused, and often to such a degree that their productions are mere

Fig. 10. Fig. 11.

From the Church at St. Gervais. Crocket for the Cathedral of Clermont.

Fig. 12.



From the Chapel of the "Hotel de Cluny."

sketches, touched up with taste. While however we refuse to the decorator of this period the gravity, which characterizes the labours of the two preceding periods, we are obliged to acknowledge that they produced works, remarkable for the luxuriance and variety of their composition, and the effect of the boldness of their undercutting. Towards the end of this century the Revival of ancient art began to take root in the midst of the productions of national medieval art, and again were oriental productions mixed with those of the indigenous Flora. The reign of Louis 12th has left us many monuments of this period of transition, among which the façade of the Chateau de Gaillon, at the Palace of the Fine Arts, deserves to be particularized, as showing the union of the two styles.

Under Francis the 1st, the revolution in art became complete, the ancient style imitated with more or less perfection, sometimes witnessed the introduction of Gothic forms, but always without any disturbing effect. The details of the tomb of Louis the 12th, and the capitals of the Chateau de Madrid, are well enough known to require only to be alluded to. It was under Henry the 2nd, that the Revival arrived at its height. The Louvre, the Chateaux of Anet and Ecouen

Fig. 13.

Bracket for a Lamp, from the Chateau de Gaillon.

and the Tomb of Francis the 1st are monuments perfect in the details of their ornamental sculpture, in which they may contend with classic antiquity, the Revival however was never a servile imitator of the Greek and the Romans. This epoch is particularly remarkable for the composition of capitals and arabesques.

From the reign of Henry the 4th, the Revival begins to lose part of its charm, ornaments became heavy, too numerous, and neglected in their execution, showing how much art had declined.

Under Louis the 13th and 14th, the direction given to ornamental sculpture was in some degree stationary, but at the end of that age, during the Regency and the whole reign of Louis 15th, the decline was rapidly going on. In fact, the corruption of form was such that no epoch in the history of the art has ever produced any thing similar. In the details of the architecture of this period, we witness the complete absence of the observation of nature, which hitherto had always been looked up to as a guide.

Under Louis 16th, it was seen how little this capricious style was adapted to the decoration of severe edifices, and a return to the antique was begun by the architects Soufflot and Servandoni. There were still to be seen however remains of the influence of that bad taste which gave way to the revolution of 1789, and the serious study of the antique which has been pursued in the 19th century.

THE ETCHING CLUB.

This association has been formed by twelve artists (eleven painters and one sculptor), composed of the following gentlemen, whose names will at once be recognized as amongst the most rising of the day:—Redgrave, A.R.A; Webster, A.R.A.; Knight, A.R.A.; Cope, Taylor, Creswick, Horsley, Townsend, Stonhouse, Bell, and F. Stone, with the view of reviving the older excellence of the art of etching, and of conferring upon the popular literature of the country, especially poetry, a more pleasing, original, and artist-like mode of illustration. The first work that they have sent forth, consists of a series of eighty-two illustrations of Goldsmith's exquisite poem, "The Deserted Village. These illustrations, in whatever way regarded, whether for originality of conception, beauty of composition, truth and delicacy of feeling, or correctness of delineation, are worthy of the highest praise. We regret, however, to perceive that the club have adopted the barbarous practice of destroying the plates after taking a certain number of impressions, which, in these days, is quite inexcusable.

FOOT BRIDGE OVER THE RIVER WHITADDER.

Sir—In the number of your Journal for July last, there is a description of a proposed new construction for railway viaducts on the tension bar principle, in which the writer refers to the foot bridge over the river Whitadder, in Berwickshire, on the property of George Turnbull, Esq., of Abbey St. Bathans, as an instance in which the principle he proposes has been applied to bridges. The principle however as adopted at Abbey St. Bathans foot bridge is not carried so far as in the proposed railway viaduct, and as it is simple in its construction, and is found to answer the purpose well, you may consider the accompanying sketch of its details not unworthy of a place in your Journal.

In 1821 Mr. Robert Stevenson of Edinburgh,* designed a bridge for the river Almond, in Edinburghshire, in which the principle of supporting the roadway by iron bars passing underneath was first adopted. This plan however differs from that now in use at Abbey St. Bathans' bridge and elsewhere, as the chains for supporting the roadway are fixed in the abutments, whereas at Abbey St. Bathans the roadway beams themselves are made to resist the strain. Mr. Smith of Deanston, has erected a foot bridge of this kind 103 feet span near Doune.

I am not aware where and by whom the plan of fixing the tension bars to the extremities of the roadway beams was first adopted, but the principle has now come into pretty general use. A beam may in this way be rendered perfectly rigid, and even forced into a slightly arched form, and from the lightness and compactness of the whole it possesses many advantages over the other methods in which the same thing is accomplished.

In 1833 a bridge was erected on the tension bar principle over an arm of the Lake of Geneva. It has 13 openings of 55 feet span, and is 25 feet broad. The same plan has been adopted for two foot bridges of 138 and 81 feet span respectively erected several years since over the river Ness, near Inverness, and also for a bridge over the river Whitadder, in Berwickshire, at Hutton Mill, designed by Mr. Jardine, of Edinburgh, which consists of three openings 50 feet span. Mr. Smith has also applied tension rods very successfully for supporting the floors of the Deanston cotton works, where they have been in use for many years. These, so far as I am aware, are the only instances in which this principle has been adopted.

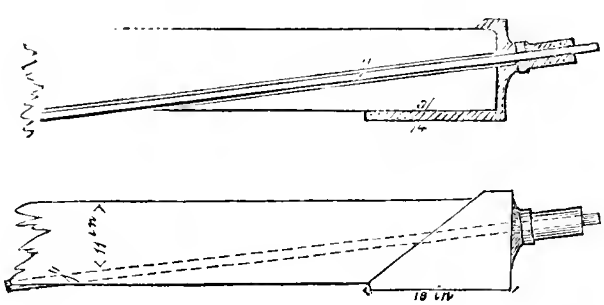
* See Edinburgh Philosophical Journal for October, 1821, and Drewry on Suspension Bridges, page 30.

The Whitadder is subject to heavy floods, especially in the winter season, which interrupts the intercourse between the opposite banks, and as there is no bridge within many miles of Abbey St. Bathans, the want of some means of communication was long felt to be a great inconvenience, and several attempts had been made to build a foot bridge by which the water might be crossed at all times, without having recourse to the inconvenient and often dangerous alternatives of a ferry-boat or a ford: but the heavy floods and ice during the winter destroyed the erections by carrying away the piers.

Messrs. R. Stevenson and Sons, of Edinburgh, being applied to for a design of a bridge, recommended one on the tension bar principle, from its simplicity of construction and the moderate cost at which it might be executed.

The bridge was commenced at the beginning of last summer, and finished in the course of six months. Its total length is 160 feet, and its breadth 4 feet. The planking is 16 feet above the water, which rises 11 feet on the piers during floods, and although the bridge was originally intended for foot passengers only, horses have been occasionally taken across it. It consists, as will be seen from the sketch fig. 1, of two main openings of 60 feet span, and a smaller one of 24 feet span. The beams are supported upon piers of coursed Graywacke rubble. The two in the centre measure 10 feet × 7 feet at the base, and batter to 6 ft. 6 in. × 4 feet at the top. The one which is most exposed to the water is founded upon rock, at the depth of 4 feet under the bed of the river, and the other is founded upon a platform of timber laid on gravel. A causeway of river stones is laid round the base of the piers to protect their foundations from the run of the water. The beams for supporting the roadway planking were made of four pieces of timber for the convenience of getting them readily conveyed across the hills; they measure 11 inches × 6 inches, and are formed of planks of red pine 11 inches × 3 inches. Two of them are 37 feet long, and two 27 feet, so that when put together the scarphs which are 2 ft. 6 in. long occur at different places and exactly over the uprights. The planks are firmly fixed together by means of oaken treenails 3 feet apart, driven right through and wedged at both ends. The ends of the main beams fit into cast iron shoes, as shown in figs. 5 and 6, and the tension rods which go under the beams, and support them by means of the uprights, pass through auger holes in the centre of the beams, and are secured by means of screw nuts 6 inches long to the back part of the iron shoes, as shown in figs. 5 and 6. The diameter of the tension rods is one inch. The screws are used in order to tighten up the rods, which is done until the beams are quite rigid.

Figs. 5 & 6.—Section and side view of the Ends of the Beams.



The main beams and iron work of the bridge were made by Messrs. J. B. Maxton and Co., of Leith Engine-works, and were proved in the work-yard with a weight of one and a half ton, before being sent to their destination. The remainder of the wood work was executed by Mr. Thomas Swan, of Cranshaw.

The entire cost of the bridge was as follows:

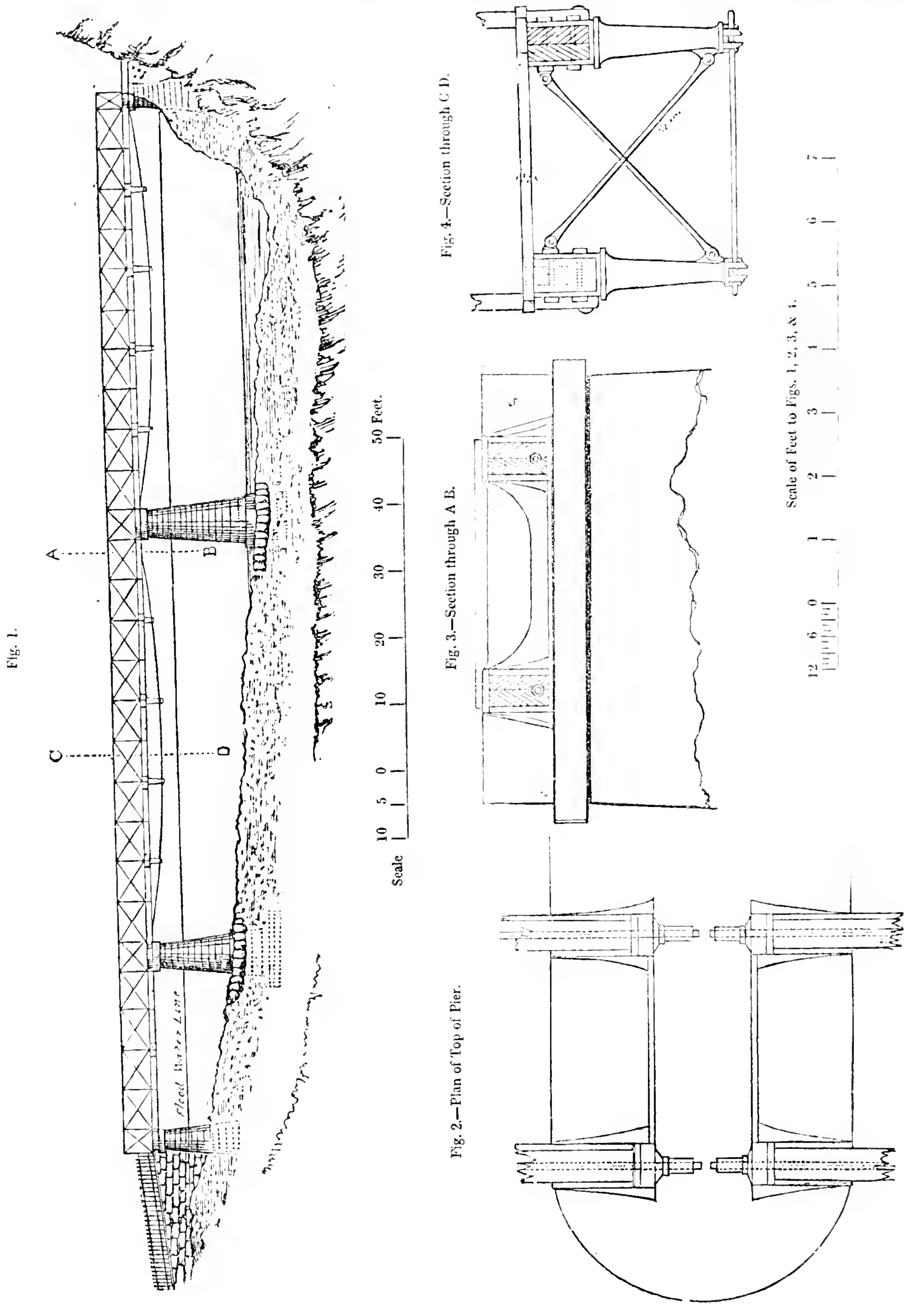
	£	s.	d.
Masonwork - - -	£101	7	5
Main beams and iron work - -	50	0	0
Planking and railing - -	78	6	0
Forming approaches, &c. - -	8	5	0
	£237	18	5

I remain, your obedient servant,

John R. Wilson.

47, *Melville Street, Edinburgh,*
27th August, 1841.

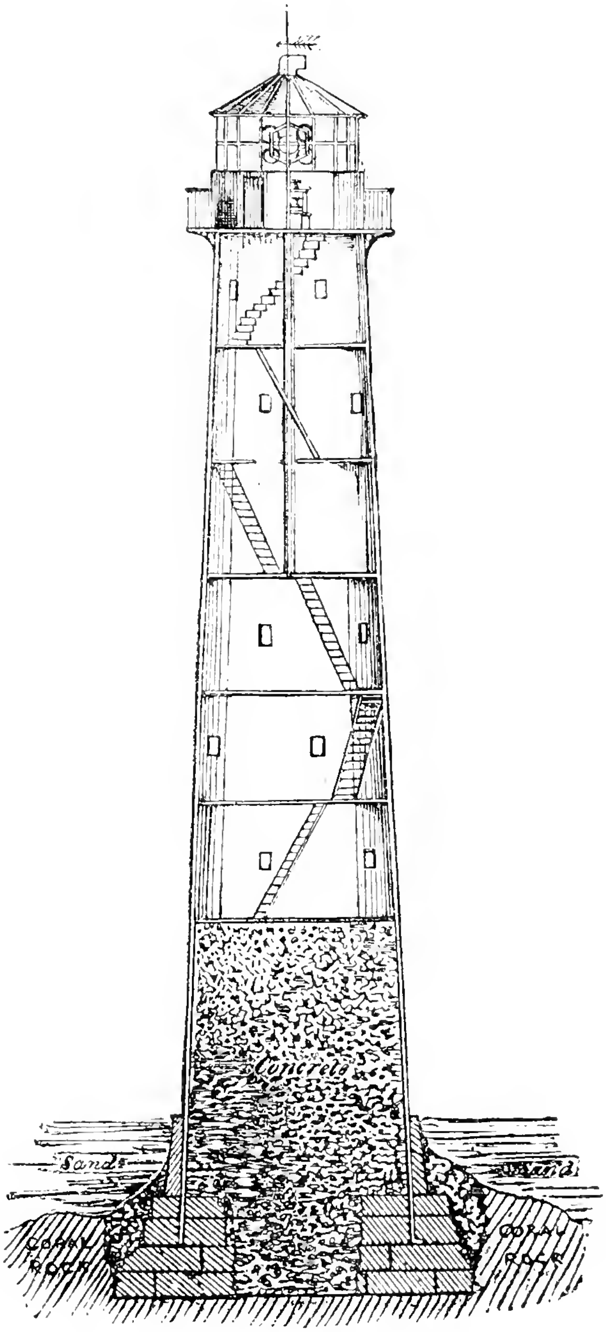
FOOT BRIDGE OVER THE RIVER WHITADDER AT ABBEY ST. BATHANS, BERWICKSHIRE.

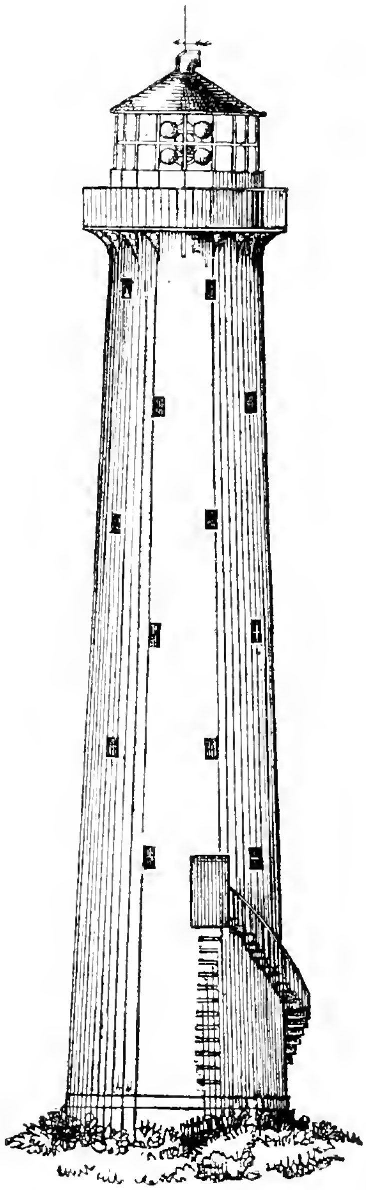


CAST IRON LIGHT-HOUSE,

In progress at Morant Point, Jamaica,

By Alexander Gordon, Engineer to the Commissioners.





In writing a description of a cast iron lighthouse tower just completed for the Island of Jamaica, an opportunity is afforded for a few words on the advantages offered by this peculiar mode of construction. Mariners have frequently been deprived of the security afforded by lighthouses on dangerous coasts, from the great costliness of such structures, as well as from the danger or difficulty attending their erection, in consequence of local peculiarities arising either from tidal restrictions, or from the difficulty of obtaining foundations of sufficient solidity to support the heavy mass of masonry of the tower. It is a fact of common occurrence that years are required to erect a lighthouse of very moderate dimensions where the rate of working is limited, both by the nature of the tides, and by the peculiarity of the season; and the authorities who preside over these matters are frequently deterred from entertaining the application, for such facilities to navigation, from the cost and trouble attending their execution.

The situation for which the lighthouse represented in the accompanying drawings is intended, has long required this protection, but the great expence of stone or brick erection, and the time required to complete them have interfered with their earlier execution to com plete the plan.

Mr. Alexander Gordon, the engineer to the Commissioners appointed to carry the plan into effect, is the designer of this building, and who recommended the adoption of cast iron, in consequence of the suggestions some years ago of Captain Sir Samuel Browne, and the subsequent erection of a small light tower on Gravesend Pier, by Mr. Clarke.

The advantages which iron, when not in contact with sea water, possesses over stone or other materials, is, that upon a given base a much larger internal capacity for dwellings and stories can be obtained with equal stability. The nature of the material admitting of the plates being cast in large surfaces, there are fewer joints, and consequently greater solidity. A system of bonding the plates may also be adopted, which will insure the perfect combination of every part, so as to form one entire mass, and by the facility which such a plan offers for uniting the parts, the best form for strength and stability can be obtained. The time required for the construction of such a building in iron being less than that required for the preparation of one of stone, would in many instances influence its adoption, and from the comparatively small bulk and weight of the component parts of the structure, much greater facilities are afforded for transporting and erecting it at its destination. It is a fact worthy of remark that in less than three months from the date of the contract, the lighthouse in question was cast and erected on the contractor's premises, and it is the intention of Mr. Gordon, the engineer, to have the light exhibited in Jamaica, on January 1st, 1842, being six months from the date of its commencement. This is a degree of expedition commensurate with the extraordinary despatch of the present day, when all operations however great and difficult, seem to advance with a celerity which a few years back would have been deemed chimerical.

The expences of the construction, the transmission to its destination, and its final erection, will not exceed one-third the cost of a stone building of equal dimensions and capabilities, and in localities where the materials are not naturally produced, but have to be transported from a distance in a fit state of immediate erection, the expence would considerably exceed this ratio. Another prominent feature in the construction of iron lighthouses, &c. is the security from electric influence, the material itself being one of the best conductors of the electric fluid, and if proper means be taken to transfer the electric fluid from the base of the tower to the sea by means of copper conductors, no danger need be apprehended from its effects.

The lighthouse in question is the first of its kind that has been practically carried out, and from its having to withstand the destructive hurricanes, which, as well as the frequent earthquakes that occur in the West Indies, it will afford a good example for future practice. The form has been selected as well for strength as for symmetry; and the arrangement of the lantern and light apparatus reflects the greatest credit on the manufacturer, Mr. Deville.

The tower is to be founded on a coral rock, a little above the level of the sea, the face of which rock is about 10 feet beneath the surface of the sand, and which will be excavated to receive the base of the tower, resting on and cased with granite, to prevent the natural filtration of the sea water from acting upon the iron. The course of granite upon which the base of the tower rests, is grooved to receive the flange of the lower plates, from which the lightning conductors are continued to the sea. The diameter of the tower shaft is 18 ft. 6 in. at its base, diminishing to 11 feet under the cap; it is formed of nine tiers of plates, each 10 feet in height, varying from 1 to ¾ inch thickness. The circumference is formed of 11 plates at the base, and nine at the top, they are cast with a flange all round the inner edges, and when put together these flanges form the joints which are fastened together with nut and screw bolts, and caulked with iron cement. The cap consists of 10 radiating plates which form the floor of the light room, and secured to the tower upon 20 pierced brackets, being finished by a light iron railing. The lower portion, namely 27 feet, is filled up with masonry and concrete, weighing about 300 tons, and so connected with the rock itself that it forms a solid core of resistance; the remaining portion of the building is divided into rooms which are to be appropriated as store rooms and berths for the attendants in the lighthouse.

The light room consists of cast iron plates 5 feet high, on which are fixed the metal sash bars for receiving the plate glass, these terminating in a point are covered with a copper roof, from which rises a short lightning rod, treble gilt at the point, to attract the electric current.

The light is of the revolving kind, consisting of 15 Argand lamps and reflectors, 5 in each side of an equilateral triangle, and so placed as to constitute a continuous light, but with periodical flashes.

In order to preserve as low a temperature as the nature of the circumstances and climate will permit, the iron shell is to be lined with a non-conducting material, such as slate or wood, leaving an annular interstice, through which a constant ventilation will be effected, and by which the excessive heat will be carried off, or which it will doubtless be assisted by the evaporation of the sea spray which may accidentally be cast upon it, as it will be placed within 60 yards of the ordinary water level.

In order to preserve the two lower tiers from oxydation, they have been coated with coal tar, and Mr. Gordon intends to set them in the granite with a bituminous cement. The only bracing which has been thought requisite is a few cross ties at each horizontal joint, over which the iron tongued wood floors are laid.

The several rooms are provided with five apertures fitted with oak sashes glazed with plate glass; the approach to the doorway which is about 10 feet above the level of the sand, will be by means of stone steps, ladder irons are also provided in the event of the stone steps being carried away by a hurricane.

Over the entrance is a large tablet of iron, supported by two small ones, and on them, in bas relief, are the following inscriptions:—

"Erected A. D. 1842,
"Under the act 3 Victoria, cap. 66.
"Commissioners.

"Vice-Admiral Sir Charles Adam, K.C.B.	"E. Jordan, Esq.
"Commodore Douglas, R.N.	"P. Lawrence, Esq.
"Hon. S. J. Dallas.	"Hon. T. M'Cormack.
"W. Hyslop, Esq.	"Hon. E. Panton, Speaker.
"J. Taylor, Esq.	"A. Barclay, Esq.
"Hon. H. Mitchell.	"H. Leslie, Esq.
	"G. Wright, Esq.

"On the designs and specification of Alexander Gordon, civil engineer. London."

And on the side supporters:—

"Captain St. John, R.A., Island Engineer."	"C. Robinson, Engineer, London, *fecit*."

The whole of the castings were executed by Mr. Robinson at his manufactory, (late Bramah and Robinson), at Pimlico, and put together in the yard of the manufactory prior to their removal for its intended destination.

The work will be re-erected in Jamaica by means of a derrick and crab from the inside, without the aid of any external scaffolding.

Arch. R. Renton.

September 22, 1841.

[We understand that the whole expence of the lighthouse, including the passage over the Atlantic, and the erecting it on the promontory in Jamaica, will not exceed £7000, and that the entire weight of iron of the whole fabric is about 100 tons. The masonry is being prepared in this country, as it will be more economical to send it from England than it will be to get the stone and work it in Jamaica. Three mechanics are also to be sent out with the work to put it together on its destined spot.—Editor.]

TURKEY.

The spirit of improvement which has been of late years exhibited by the Turkish government has not been confined to political and social reforms, but has also been directed to objects of a practical nature. In aid of these efforts frequent calls have been made on the talents of our engineers, and some very fine machinery indeed has been sent out to Constantinople. Much of this has been on a very large scale, and we may enumerate saw mills, musket machinery, and gun-boring machinery. The machinery supplied by Messrs. Maudslays for boring brass guns, said to be the finest and most extensive of any in the world, has given great satisfaction. The same firm have lately finished an order for mint machinery, also on a large scale, which has excited great commendation from the completeness of its design, and the beauty of its execution. It consists of two 16 horse power high pressure engines, two pair of large rollers, and two pair of smaller rollers, six cutting out presses, two double draw benches, four coining presses with pneumatic apparatus, and a die sinking press, with two double acting milling machines, ingot moulds, &c. To those who admire this class of machinery, as who does not, the examination of this minting apparatus was highly interesting, uniting as it did all the recent improvements which have been adopted in our mint. The Turkish dockyard it must be farther remembered, is directed by an Anglo-American, and is in a very efficient state, and the public at Constantinople have recently been turning their attention towards steam navigation, so that we may look forward for a new market for our machinery in the Turkish empire. To the engineering and mining interests the progress of this increasing branch of our commerce is of great importance.

IMPROVED CONSTRUCTION OF PISTONS AND VALVES, FOR RETAINING OR DISCHARGING LIQUIDS, &c.

Patented by Messrs. G. H. Palmer and Charles Perkins.

Fig. 1.

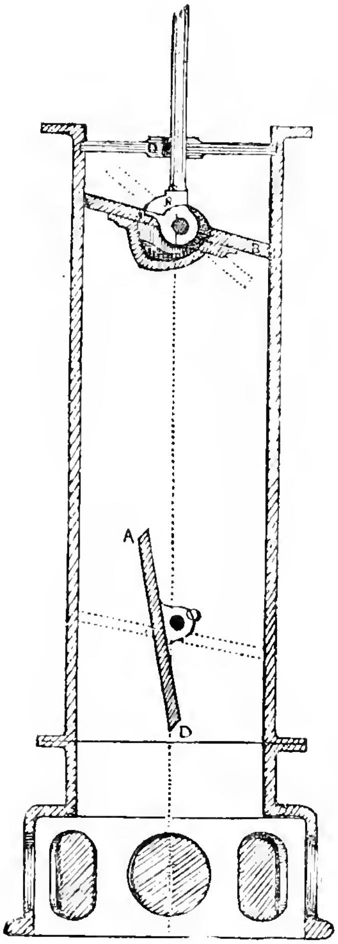


Fig. 2.

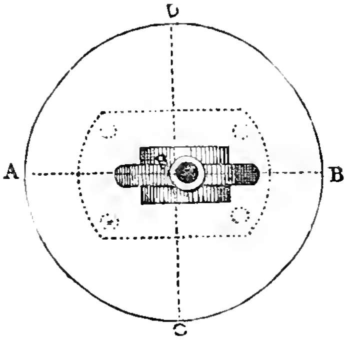


Fig. 3.

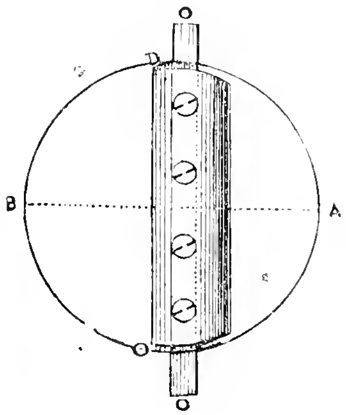


Fig. 5.

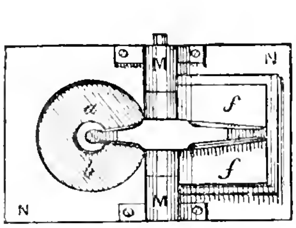


Fig. 4.

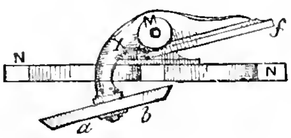


Fig. 1, is a plan of the piston, a section of which is shown by fig. 3. A B the major, C D the minor diameter; the joint (by which the pump rod is secured), is in the centre of the true line of the major diameter A B, but neither in the centre of the pump or piston, being removed therefrom more or less as the diameter of the pump, the altitude of the column of water lifted, and other circumstances may require. The whole area of the piston is therefore divided into two unequal areas.

Fig. 2, is a plan of the lower valve, which is fixed in the barrel by means of the axle O, the eccentricity of which is regulated upon the same principle as that of the joint in the upper valve or piston.

Fig. 3, shows the relative position of the piston and valve during the upward or effective stroke. The dotted lines show the position of the valves in the downward or return stroke.

Figs. 4 and 5, are a plan and section of a patent double balancing valve, an application of the same principle as adapted for safety, or any valves connected with steam engines or air pumps, also to lock gates or sluices, and generally as a simple and effective mode of retaining or discharging liquids, gases and steam. The two valves being of unequal, but the inner of the greater area, and the pressure upon both, being in the same line of direction, it is evident that the power to open or shut them may be determined at pleasure by regulating the difference between the two areas, *a b* is the larger, and *f f* the valve of smaller area, each of which are connected with, and works upon, the axle M M, supported by carriages on the valve bed N N. The valves *a b* and *f f*, receive simultaneous action by means of the curved lever or tail piece X.

The patentees recommend the adoption of the patent elliptic self adjusting balancing pistons in all pumps for whatever purposes intended, as the most simple, durable and effective of any arrangement now before the public. Simple, as is evident from the diagrams and description herewith. Durable, because the process of raising water from any depth is performed by two metallic discs, not liable to derangement, and free from most casualties of climate, circumstance, or wear. Effective, first, because a very superior water way is obtained, (there are no valves to clog or gag, no resting place for any extraneous matter to impede the duty of the pump, whether it be sand or rubbish). Secondly, it will remove the evil arising from concussion in pumps of large diameter; and thirdly, in consequence of the decreased amount of friction, the service of a man in pumping is increased in the ratio of nearly 3 to 1, as the following statement will demonstrate.

The patentees have two 10 inch pumps, the levers 6 to 1, the stroke 8 inches, the column of water 5 feet; both pumps were made by Messrs. Bramah and Robinson, in their best manner; alike in all respects, except that one is fitted with the usual packed bucket and butterfly valves, the other with the patent piston and valve. In an experiment recently made with weights over a pulley, it required the exertion of a force equivalent to 461 lb. to raise and deliver the water, (about 2 gallons), and return the bucket with the packed pump, and only 19.5 lb. to do the same work with the patent pump; making the labour to work the two pumps in the ratio of 461 to 196 = 23 to 10.

Another experiment was made for the patentees by Mr. Beale, of Greenwich, showing similar advantages in the diminution of friction, and consequently an increase power. The following is the result of this experiment.

A vessel of a capacity equal to 314·16 gallons = 3141 lb. was filled by pumping 140 strokes in $1\frac{1}{2}$ minutes, which was at the rate of 31 strokes per minute, and 2·244 gallons per stroke. The working barrel of the pump was intended to be 10″, but was said to have been turned to $10\frac{1}{4}$ inches nearly.

If the diameter was 10, then the delivery by computation in 140 strokes of 8″ = - - - - -	318 gallons.
If the diameter was $10\frac{1}{4}$, then the delivery = -	330
The actual delivery was by computation of the receiving vessel = - - - - - - -	314

The average lift during this time was about six feet.

In a second experiment the water in the well was kept at an average height which, with pipes added to the exit pipe, made the total lift 15 feet 4 inches.

Under these circumstances weights were applied to the end of the lever, and it took 98 lb. × 6 the leverage to raise the column of water.

Now 98 × 6 = - - - - - - - -	588 lb.
The actual weight of a column of water $10\frac{1}{4}$″ diameter and 15 feet 4 inches in height, is - - - - -	550 lb.
Leaving for friction in the up stroke only - - -	38 lb.

As there was no friction in the down stroke or return of the piston, it results that 38 lb. was the total amount of friction out of 588 lb. (exerted), being only 6·46 per cent. or $\frac{1}{16}$ part.

The velocity of the water may be taken at 20 feet per minute.

In a third experiment, to produce a *maximum* effect, two men made 41 strokes in one minute, lifting the water 15 feet 4 inches, and delivering as per first experiment 2·244 gallons, or 22·44 lb. per stroke = to 14107·28 lb. raised one foot high in one minute by two men, or 7053·64 lb. raised one foot high in one minute by *one* man.

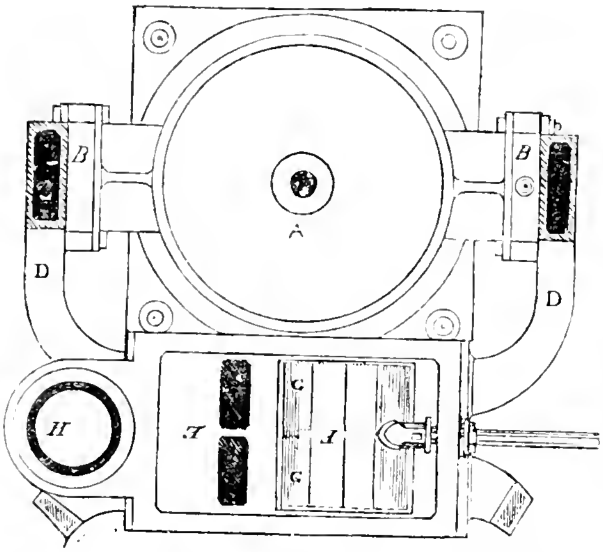
Artificial Ice.—The projectors of the artificial ice plan have found a site in the New Road, opposite Lord's cricket ground. We have seen the composition, which seems to succeed, and the plan is approved by the Skating Club.

ON REVERSING OF ENGINES.

Sir—When we look to the methods of reversing the motion of reciprocating steam engines which have hitherto been generally adopted, it becomes a matter of surprise that, whilst in almost all patents for rotary engines, where it has been considered the motion would want reversing, it has been done on the principle of changing the steam induction and eduction passages, (*i. e.* what is the induction for one way is made the eduction the other, and *vice versâ*), the same principle has not been adopted for them. The most general and simple way of changing the passages in rotary engines has been by means of the common slide valve, and my object in now addressing you is to propose the adoption of the same slide valve to the reciprocating engine.

The accompanying figures represent it as applied to a pair of marine engines, for which it seems particularly suited. Let A in the figures represent the cylinder; B B B B, valve boxes fitted with stop valves *v v v v*, almost similar to those of Messrs. Seaward's patent, except that both the valves and boxes are faced on both sides; C 1, C 2, communication pipes to each pair of boxes; D D, branch pipes from C 2, C 1, to the apertures in the slide valve box E; being alternately steam and exhaust as their respective apertures may be covered by the slide valve F; G is the exhaust or eduction to the condenser; H the induction or steam-pipe from the boiler. The valves strike simultaneously (as Seaward's), and are like them worked by one fast eccentric.

Fig. 1.—Plan of Cylinder.



It will be seen as the valves stand in the figures that the steam passing down H into the valve box E, and down the uncovered apertures to communicating pipe C 1, finds the upper aperture stopped up, it consequently makes its way through the lower one and forces up the piston, at the same time the upper valve on the other side of the cylinder is open, and a vacuum being formed in the condenser, it exhausts G, under F, the branch to and the communicating pipe C 2, and the portion of the cylinder above the piston.

If we wish now to reverse the motion, we have only to push the valve F to the other end of the box, as represented by dotted lines in fig. 3, the branch pipe, and C 1 is open to the condenser, and the steam passes down the branch into C 2, and presses down the piston.

The mode of operation will I think be now understood. Fig. 4 is a view of the valve F, as proposed for a pair of engines, showing the midfeather to separate the exhausts or eductions to the respective condensers. The branch pipes to the other cylinder are shown broken off. There is another use of the valve F, it is a perfect regulator or throttle valve, to stop or regulate the engine by; for it is so constructed that supposing the steam to be shut off by it when running either way, still the exhaust apertures remain entirely open. The simplicity of its action, and its doing away with a considerable number of small moving parts consequent on reversing and management in general, by the present methods are its recommendations, not to mention that one man could manage a pair of the largest engines which have yet navigated the ocean, better than 4 or 6, or even 10 men, to some of our

Fig. 2.—Section of Cylinder.

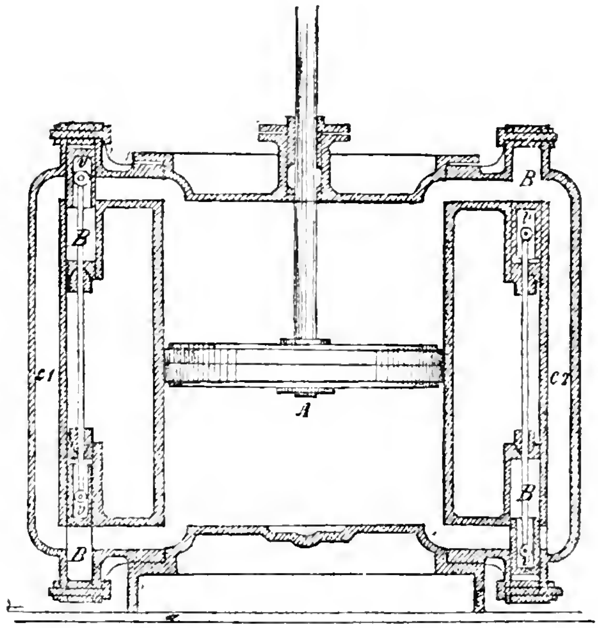


Fig. 3.—Elevation of Cylinder and Section of Valves.

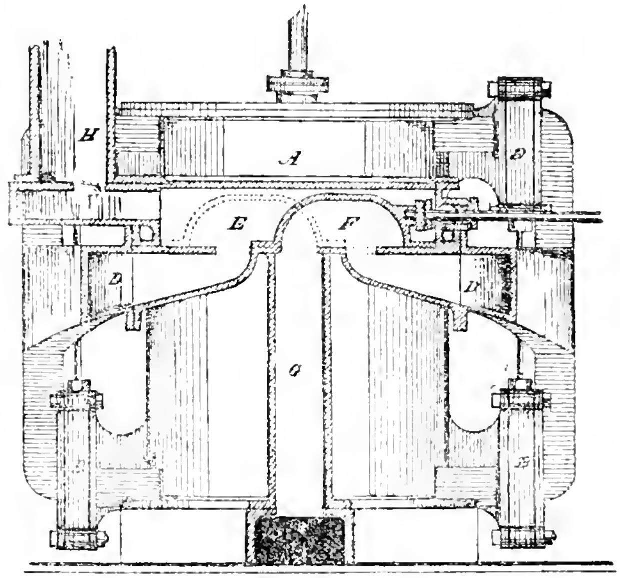
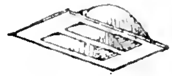


Fig. 4.



present large marine engines. I have a sketch by me, only in pencil as yet, for working locomotives by the same principle, but being so confined as to space, little difficulties present themselves in the arrangement, which a more practical man might soon set aside.

Your's,

G. Coe, Civil Engineer.

Horbury Bridge, near Wakefield,
August 17, 1841.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXI.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. Those who rail against competition, not because competitions are for the most part vilely conducted—most bunglingly also, supposing there to be honesty of intention, or else most fraudulently, as there is frequently good reason to suspect, perhaps all but positive evidence to prove—the declaimers against competition, carefully keep out of sight the mischiefs that have been produced by non-competition. It is impossible to believe that Buckingham Palace would have been the miserable architectural abortion it now is, an object of shame to Englishmen, and of contempt to foreigners, had others been allowed to measure their talents with those of John Nash. In such case an open competition might not have been at all advisable, but a middle course might have been pursued, and a certain number of those of most likelihood in the profession should have been invited to send in designs, and every set of drawings should have been paid for except those by the successful architect, who would be amply remunerated otherwise. A thousand pounds a-piece would not, perhaps, have been at all too much: while it would have been sufficient to induce those selected as competitors to exert themselves heartily, it would not have been an extravagant reward, considering the study such a subject would have required, the expenses the competitors must have incurred, and the other engagements they must have neglected or postponed. Supposing the number of competitors had been ten—it might have been fewer, the £9,000 would not have been recklessly squandered. Even supposing the result had been precisely the same as at present, we should at least have had the satisfaction of knowing that the bauble we have now got was the very best thing of its kind that was to be had. As it is, there was the saving of a few thousands in the first instance, and we have got John Nash's chef-d'œuvre—no very great bargain after all, any way, when we take into account the tens of thousands expended in pulling down and re-building, while it was in progress, and afterwards in botching it up and licking it into shape.

II. The anti-competitionists would do well to consider what sort of design we should have had for the new Houses of Parliament, had there been no competition, but a Nash, a Soane, or a Smirke, been called in, and left to do his best or his worst, and to go on as he pleased without further inquiry. Without much fear of contradiction, it may be affirmed that had there been a competition for the National Gallery, we should have had something better rather than worse than the present structure; and the same may be said in regard to a great many other buildings. Of course it must be assumed that the competition is fairly managed, and that there be not only perfect fairness, but the requisite taste and judgment also. It is no satisfaction to be assured that the decision has been made to the best of their ability by those with whom it rested, if the choice itself convicts them of utter inability and incapacity for such office. If associated with bad taste, honesty may do more harm than good in such matters; yet as far as honesty is concerned, there is very little danger of any mischievous consequences from excess of it, at least not just now, for, if reports may be credited, some very ugly instances of thorough-paced roguery and rascality in the management of competitions, have recently taken place.

III. If no other, there is at least one remarkable peculiarity attending architectural criticism, viz. that so far from endeavouring to be *au courant du jour*, it generally lags most wofully behind-hand, as if it were almost a positive breach of decorum, to discuss the merits of productions belonging to our own times. Why it should be considered requisite to exercise such forbearance towards living architects and their works, more especially, the very reverse of it being frequently manifested in the case of literary men, actors, artists, &c., it is difficult to understand. Neither is such over-delicacy particularly complimentary, since it almost amounts to a confession that it is impossible to speak honestly of the living without also speaking harshly, therefore the critic who would neither give offence nor compromise his own judgment, has no other alternative than silence. On the other hand, however, Brummagem criticism and puffery are allowed to circulate freely enough; for though delicacy may withhold some from giving their opinion unreservedly in the case of architects either living or recently deceased, many there are who do not scruple to cry up almost every thing as a wonder of its kind. With them every goose is a swan, or rather a phœnix. Whatever they are speaking of is, for the time being, superlative of its kind. Their chief merit is their impartiality, since they treat all alike, making no distinction between a Charles Barry and a Richard Brown. Yes, incredible as it may seem, even Professor Brown has his admirers; not long ago a flaring-up puff appeared in a weekly paper on the Professor's "Domestic Architecture," bearing testimony to the value of the work, and the varied talent displayed in the designs, "which would afford to the student examples in every style of building"! Thus a publication which is absolutely pestiferous in taste, and as far as it circulates, is calculated to spread the most vulgar taste throughout the land, not only escapes reprobation, but is actually recommended as an authority and a trustworthy guide. Pity it is that Pugin did not show up some specimens of his brother Professor's designs along with "castellated" firegrates, and similar monstrosities. Should Welby not be yet aware of the existence of Brown's publication, we earnestly recommend it to *him*, for he will find in it some exceedingly piquant tid-bits, *inter alia*, a sample of Egyptian that might very well pass for one of the plagues of Egypt.

IV. Want of keeping is so exceedingly prevalent a fault in architectural design, that it would seem to be the most excusable of any, as being of all others, the one most difficult to be avoided, whereas I should decide precisely the reverse, it being, in my own opinion, one of the most offensive and the least venial, because that which argues the absence of artistical feeling. In every composition there ought to be some leading features, and some parts of a building will very properly bear to be more ornamented than the rest; yet this should be so managed that the *ensemble* shall appear consistent, and the whole design all of a piece as to taste. Look at the Post Office—there are Ionic columns, but the structure itself is absolutely dowdy in its style. Look at the Post Office, Dublin—there we have another large Grecian Ionic portico attached to a very plain and ordinary house-front. Look at Goldsmith's Hall—the lower half of the design is altogether different and distinct in character from the upper one. Look again at Lord Sefton's new mansion in Belgrave Square—within a carriage porch of the very plainest Italian Doric possible, is a doorway of unusually rich design, which, in such situation, looks as much overdressed in itself, as it causes the columns and their entablature to look plain, even to the appearance of being unfinished. In a new house near Park Lane, I observe there is some approach to the Italian style, the elevation being crowned by a cornice somewhat bolder and richer than usual; but the windows!—they are in the modern Pseudo-Grecian fashion, with no other dressings than architraves, and those of the very plainest description. In all such cases it looks as if the architect had been obliged to pare down his design in order to save expense, and that, instead of simplifying it consistently throughout, he had merely omitted in execution that decoration which was in the first instance proposed as essential to unity of expression.

V. Another great and pervading vice in modern design is that so little regard is had to the sound and legitimate principle of commencing decoration by first applying it to essential features—those arising out of construction, or required by utility and convenience, instead of introducing what is merely for embellishment, while other things that cannot possibly be omitted or got rid of, are left not only plain, but quite rude in appearance, so as to become, by contrast, positive eyesores. That such errors in taste—such violation of all artistic principles of composition, should ever be committed, is grievous enough, but that it should be committed so very frequently, and by those who are so fastidious and puritanically pedantic in regard to matters of infinitely less importance, is most grievous and most provoking. Utility and beauty ought to go hand in hand, but should be made to do so after a very different fashion from what is now generally the case, when one half of a design aims at nothing more than unadorned usefulness, and the other at ostentatious show. Their usefulness does not reconcile us to ugly chimneys and chimney-pots confusedly huddled together on the roof of a building—to bare openings for windows, or else having only some scanty common-place mouldings bestowed on them,—to insignificance and vulgarity as regards matters of that kind, while unnecessary and inconsistent, therefore absurd parade is indulged in as regards others. One ill consequence of such unfortunate system is that people are satisfied with mere shreds and patches of design, and think it quite enough if they are able to say such or such a part is very good, though the general effect may nevertheless be poor in the extreme, and the whole no better than a jumble of the most incoherent and contradictory members.

Progress of Steam.—We learn that in a short time the merchants of St Petersburgh will have a direct line of steam communication, *via* the North of Germany, Yarmouth, and this city, with New York.—*Bristol Standard.*

ARCHITECTURE AS A FINE ART: ITS STATE AND PROSPECTS IN ENGLAND.

By George Godwin, Jun., F.R.S.

"That art where most magnificent appears
The little builder, man."

"I shall not neede (like the most part of writers) to celebrate the subject which I deliver. In that point I am at ease. For architecture can want no commendation, where there are noble men and noble mindes." So wrote Sir Henry Wotton more than two hundred years ago, with reference merely to the Roman style, when classic architecture was but beginning to revive:—before Inigo Jones and Sir Christopher Wren had nationalized it amongst us, or Lord Burlington's example and endeavours, had made a smattering of its principles almost a necessity of fashion. Since then, the treasures of Greece have been ransacked and sent home to us to correct our taste and aid the study; the claims of middle-age architecture to be regarded as the work of supreme genius have been admitted universally, (its intrinsic beauty, the extraordinary skill displayed in its development, its power of inducing

"A stir of mind too natural to deceive;
Giving the memory help when she would weave
A crown for Hope!"

have all been felt,) and delineations of its choicest specimens in a thousand and one books have been dispersed amongst us to render its details more known, and its imitation less difficult.

The history of architecture has been written,—the beautiful relationship of the various styles has been shown, (each growing out of and in its turn producing,—) forming a narrative most interesting and striking to all who look not carelessly on the progress of the human family, and sufficient it might be thought, to arrest and retain the attention of all readers. The history of our ancient buildings is more fully felt to be inseparably connected with the history of our country,—every old stone in England is known to tell a story, and therefore should have now a firmer hold upon the people than then, and yet we doubt whether any might venture to repeat at this time Sir Henry Wotton's remark which we have quoted. Certain it is that many "noble men" care nothing about architecture, and that many more "noble mindes" seem to require it should have very much "commendation" before they will be induced to give attention to it.

The degree of ignorance on the subject of architecture to be found amongst persons in other respects not merely well informed, but even learned, is quite extraordinary. Grecian, Roman, Gothic, Elizabethan, as applied to architectural style, are to them but words without any corresponding ideas; they have never considered that architecture has a chronology, still less, a philosophy,—architectural integrity, harmony, proportion, fitness, are to them foreign things,—in fact, beyond a notion that architecture means piling one stone upon another, and forming places to live or meet in, they know nothing and care less.

Great part of this inattention on the part of the multitude to the interesting and noble study under notice, (and of which the results whether for good or ill, usually endure long, and are constantly before the eyes of all,) has been justly ascribed to the connection which exists in the public mind between architecture as a constructive *science*, and architecture as a *fine-art*, and every endeavour ought therefore to be made to enforce a knowledge of this difference on general readers, and to point out to them how large a source of fresh delight would be opened to them by its study in the latter point of view. The pleasure of travel is trebled by it. Proofs in aid of former studies, objects for investigation, incentives to inquiry, arise on all sides; tongues are literally, found in stones, and a habit is acquired of weighing causes, and testing by judgment whatever is brought before the mind, which is of the greatest value, not merely in this particular case but in all the affairs of life.

For the sake of example, but briefly, let a man possessed of its history, and imbued in some degree with its principles, visit, in company with one entirely ignorant of both, an old town, or be set down before a new building. In the first, he might perhaps find a massive piece of walling, formed of beach-stones imbedded solidly with mortar, and bound together at certain distances in its height, by layers of long thin bricks almost resembling tiles. This he would at once recognise as a remnant of the work of that period when the Romans brought, though as conquerors, the arts to England, and laid the foundation for after-elevation and prosperity. Britain and its skin-clad inhabitants, the invasion of Cæsar, the downfall of Rome, the invitation to the Saxons would be the concomitant remembrances.

One of the gateways leading into the cathedral-close—which we will suppose the town to possess, might present semi-circular arches springing from small columns, and ornamented on the face with a rude zig-zag moulding, or a series of bird's beaks, which he would know to be the design of some of those Norman architects who, after the conquest of England by Duke William, employed themselves actively for some time, in covering the land with donjons and churches. The abasement of the Saxons, the curfew, forest laws, the feudal system generally, would pass involuntarily through his mind, and afford matter for long and pleasant reflection.

The cathedral itself would perhaps display in part, the feathery lightness of the pointed style of architecture with lofty arches, pinnacles and buttresses, intermixed with work of later date, shewing arches almost flat, superfluity of adornment, and the decay of taste: all which would be sufficient not merely to recall to the initiated beholder the changes which took place in architecture during two or three hundred years, and ended in the importation of a style from Italy, in the reign of Charles I, or a little earlier, and a contemptuous disregard of the beautiful structures before spoken of, and then first termed *Gothic*, in derision,—but would bring before him the progress of Christianity, the power attained by the clergy, and the state of the country and the people, in a variety of fresh phases.

At the new structure again, he would perhaps see the clever adaptation of means to an end, and proportions well preserved; read in its architectural expression an accordance or otherwise, as the case might be, with its purpose; and study the causes which conduced to render the effect of the whole on the mind satisfactory and pleasing. Thus would the imagination of the one be gratified, his judgment strengthened, his sagacity increased, while the second, who had given no thought to the subject, and had gained no information upon it, would necessarily be blind to it all, or seeing, would understand not.

The analysis of the causes of beauty in works of architecture, is certainly far from an easy task: it yet remains for some powerful mind keenly perceptive and nicely discriminating to deduce a code of laws or principles to be universally applicable in this inquiry. Whether however, this is likely soon to be effected, or that these subtle properties will continue to evade reduction to general rules, it is difficult to say. At present we must be contented to apply in individual cases, a number of unconnected canons, and to investigate the particular results of certain arrangements of form, compliance with prejudices, or the production of novelty.

"The art which we profess," says Sir Joshua Reynolds, speaking of painting, "has beauty for its object: this it is our business to discover and to express; the beauty of which we are in quest is general and intellectual; it is an idea that subsists only in the mind; the sight never beheld it, nor has the hand expressed it: it is an idea residing in the breast of the artist, which he is always labouring to impart, and which he dies at last without imparting—but which he is yet so far able to communicate, as to raise the thoughts and extend the views of the spectator; and which by a succession of art, may be so far diffused that its effects may extend themselves imperceptibly into public benefits, and be among the means of bestowing on whole nations refinement of taste." Now in architecture, which is not an imitative art, but one of imagination and adaptation, if we may so speak, (born of necessity,) there are two other objects to be attained, namely, commodiousness, (or fitness for the purpose,) and stability: in reference to both of which, although perhaps it is not for these it is entitled to the appellation of a fine art, the claims of a building to perfect admiration must be tried. It seems clear that these qualities may exist without the production of beauty, even with *proportion* of the parts superadded,—(a word by the way the meaning of which is any thing but precise, as what is deemed proportion under some circumstances, or in one place, is not so in others:) but the production of beauty which will satisfy the mind can hardly be hoped for without minute attention to all these points. Variety and intricacy, with yet a prevailing uniformity, may be regarded as important in the production of pleasure in the spectator:—in so far as while the mind is able at once to comprehend and dwell upon the unity of the whole, it may be interested in the novelty or propriety of each detail, and find delight in this indication of the energy, ingenuity, and power displayed in its formation. We must not however here venture on an inquiry, which interesting as it may be, is beyond the intention of the present paper.

To return, then, to our former subject. The neglect which architecture has experienced at our universities (as, indeed, have all the arts), is another plainly apparent cause of the ignorance complained of, and it is gratifying to see indications, although but partial, of the presence of a different spirit amongst the members of the universities, if not in the universities themselves. Oxford and Cambridge both have now societies for the study of Gothic architecture, and for the purpose of aiding in the proper restoration of old buildings. Many papers of great merit have been read at both, and museums of casts have been commenced, classified in such a manner as to aid materially in impressing on those who will study them, the peculiarities and characteristics of the various æras in architectural history. In Bristol a similar society has been formed recently, and it is to be hoped that the example will be extensively followed throughout England.

Among the important advantages, not before alluded to, as certain to arise from the spread of architectural knowledge, would be an almost immediate improvement in the professors of the art themselves. Improve the capacity of the judges, raise the ordinary standard of taste, create a demand for superior skill, and the result inevitably must be that individuals will be found capable of supplying it, and that fine works will be produced.

The association of architects not merely for the study of their profession and the interchange of opinions and kindly feelings, but with a view to popularize their art, and by spreading abroad their Transactions, and inviting strangers to their meetings and *conversazioni* to render it matter of general interest, must be regarded as likely to assist greatly in removing the ignorance complained of. The Royal Institute of British Architects, a chartered body, including in its list of members the greater number of the heads of the profession, in correspondence with most of the continental states, and presided over by one of the most accomplished noblemen of the day, may be considered as the chief of these associations, and has it in its power to influence the age very materially—more so indeed than it has yet attempted to do. The publication of a volume of its transactions, at least annually, should be regarded by the members as most important, while, to make these transactions valuable and effective, should be the constant study of all who are connected with the Institute, or wish well to their art.* The London Architectural Society, the Institute of Irish Architects, and the Manchester Architectural Society, are all influential bodies of a like character, and are called on to exert efficiently the power which is in their hands.

At the Royal Academy, where of late years an inexcusable degree of inattention to architecture has been manifested, affairs are wearing a more promising aspect. The present accomplished professor, Mr. Cockerell, has entered on his duties with singular and praiseworthy zeal, and eminent as he is for a love of his art and desire to spread a knowledge of it, will not fail to pursue them energetically in a right course. The establishment of schools of design throughout the country (in the arrangement of which Mr. Cockerell has taken active part, as also did Mr. J. B. Papworth,) will be of great service to architecture, by increasing the number of those able to carry out effectively the designs of architects, while, by imbuing artizans with an artistical feeling, they will serve materially to raise their callings in the scale of society. How greatly the architects of the middle ages were indebted to the ability and feeling of their operatives is too well known to need notice here.

The want of information, and the low state of architectural taste, which have been complained of as still existing, have been strikingly exemplified in the results of many competitions for designs which have been brought before the public within the last ten years. The insufficient particulars and instructions given to architects, the want of courtesy displayed towards them, and the ultimate unjust decisions, have proceeded in as many cases from entire ignorance, with a wish to act rightly, as they have from underhand influences and bad motives. And until we can in some degree remove these first-mentioned evils, we can hardly hope, however much we may strive, to prevent this injurious result, injurious not less to the public than to the artists and art itself. That artistical competitions, by affording opportunities for the encouragement of unaided merit, by preventing professors of established practice from falling into a routine habit of composition, and by inducing young men to study subjects which otherwise might not come under their notice—are advantageous, is the opinion of the great majority of those who have thought upon the matter. We would go so far as to say that for *all* works entitled by their destination or importance to be called national, the nation should unquestionably be appealed to, and opportunity thus given for unknown talent to come forward.

Brunelleschi, Michael Angelo, Palladio, Fontana, Scamozzi, are all to be found in the list of those who competed for the honour of conducting important works in Italy. In England, however, until the decision in these matters can be more depended on than now, (when, in fact, the administration of every succeeding competition is worse than that which preceded it,) men of integrity and ability who have reputation to lose, will not enter the lists except in special cases, and the result must be that the field will be left chiefly to unemployed tyros or manœuvring traders.

If we be correct in our opinion, that until information be spread and the taste of the multitude be improved, we cannot expect to effect much alteration, it is to this end surely we should apply all our efforts, vigorously and unceasingly. Why should not architecture and the other fine arts be taught universally in our schools, and be made a necessary part of a liberal education? At all events, professorships should unquestionably be instituted at the universities, to spread a knowledge of the beautiful, and inculcate a love for it. Every day is science exerting its powerful influence to liberate men from the necessity of manual labour. Every day, therefore, does it become more and more necessary that unemployed minds should be put in the right track, that intellectual and moral wants should be created, and that all means be taken to elevate the taste of the multitude, and supply their cravings for excitement with proper *pabulum*.

To improve a love of the fine arts amongst a people, not irrespective of RELIGION, but in connexion with it, must be regarded by all wise and enlightened statesmen as an object of paramount importance, to be attained almost at any price.

* If a monthly *bulletin* were issued in a cheap form, containing an abstract of each night's proceedings, it would be of much service. Unconnected items of information elicited in conversation, and papers not sufficiently important to appear in the "Transactions," might therein be recorded. Information would thus be spread, and there would be an additional motive for members to communicate matters which, though trifling in themselves, might be important in the aggregate. Besides, the more the fine arts are talked about and written about—the oftener they are brought under public notice, the more likely it is they will receive general attention. The public require a thing to be said a great number of times, and in a great many ways, before they will hear it.

ENGINEERING WORKS OF THE ANCIENTS, No. 9.

In our present paper we conclude our extracts from Strabo.

THE GREEKS.

The silver mines of Attica (Book 9, chap. 1), were formerly very productive, they are now exhausted. When they still produced a slight return for the labour of the miners, they melted up the old rubbish and scoriæ, and a considerable quantity of very pure silver was obtained from them, seeing that the ancients were not very skilful in the art of extracting metal. A commentator remarks on this passage that it is a proof of the progress of mining in this age, but that even then the Romans had been by no means gone to the extent of modern art, as sufficient is still sometimes found in Romish scoriæ to pay for the expense of extraction. He farther observes that the mines of Laurium showed signs of exhaustion in the time of Socrates (Xenophon Memorabilia, book 3, chap. 6, § 12.)

In the next page Strabo notices a bridge over the Cephissus.

In book 9, chap. 2, our author gives a description of the works on the Euripus, but one which is very inaccurate.

Speaking of the plains of Beotia opposite to Eubea (book 9, chap. 2), an account is given of the works undertaken to drain them by a contractor for works of the name of Crates of Chalcis. He was obstructed by the factions among the Beotians, but in a report, addressed by him to Alexander, he relates that he had already drained several large tracts. This contractor is also mentioned by Diogenes Laertius, book 4, § 23, as being employed by Alexander.

In book 10, chap. 1, is an obscure passage relative to the mines of Chalcis.

In the same, chap. 3, Strabo refers to the labours of Hercules on the Achelous.

The Rhodians as well as the Cyzicans and Marseillese were famous as military engineers (book 14, chap. 2.)

CILICIA.

Book 12, chap. 1, contains an account of the mode in which King Ariarathes the 10th stopped up the Melas, a feeder of the Euphrates, and how the dike having burst and caused injury to the neighbouring lands, the king was fined 300 talents by the Romans.

PONTUS.

Chapter 2nd of the same book describes the mode of working the mines of Sandaracurgium.

EPHESUS.

The entrance of the port of Ephesus is too narrow, the fault of the architects and engineers, who were led into error by the king, who employed them on this work. This prince, who was Attalus 2nd, Philadelphus, King of Pergamus, seeing that the port was being silted up with banks from the deposits of the Cayster, and thinking that it could be made deep enough to receive large vessels, if a mole were thrown before the entrance which was too broad, ordered the construction of the mole. The contrary however happened, for the mud filled the port with shoals as far as the entrance, whereas before the deposit was sufficiently carried out by inundations, and by the reciprocal movement of the waters of the outer sea. Such are the defects of the port of Ephesus (book 14, chap. 1).

PERSIA, &c.

Alexander in his expedition to Gedrosia was preceded by miners to search for water (book 15, chap. 1).

In book 15, chap. 3, a bridge is mentioned as being thrown over the Choaspes at Susa.

In the next page sluices are mentioned on the Tigris.

In book 16, chap. 1, an enumeration is made of the works of Semiramis.

Alexander destroyed a number of sluices on the river Tigris. He also occupied himself with the canals, which are of the greatest importance to the agriculture of that country (B. 16, ch. 1), a theme upon which our author dwells at some length. He relates, on the authority of Aristobulus (see also Arrian, B. 7, § 22), that Alexander, seated in a boat steered by himself, attentively surveyed the canals, and caused them to be cleaned by employing a great multitude of men, whom he took with him, He also had certain outlets closed and new ones opened. He remarked a canal, principally leading to the lakes and marshes on the Arabian side, and the outlet of which, on account of the softness of the ground, could not easily be closed; he therefore opened a new canal or mouth about 30 stades off, in a rocky ground, through which he turned the waters.

EGYPT.

In his 17th Book, Strabo describes Egypt. He mentions the skill the Egyptians showed in hydraulic works, but the fact upon which he dwells is partly perhaps attributable to Roman science. He says that before the time of C. Petronius (ch. 1) Governor, A. D. 20, that the greatest inundation and most abundant harvest took place when the Nile reached fourteen cubits, but that under the administration of that governor an inundation of twelve cubits produced abundance.

In that book and chapter there is frequent mention of canals, and there is a description of the canal of the Red Sea. (See also Diodorus Siculus, B. 1, § 19 and 33.

Here also Strabo describes the Egyptian mortar as being made of pounded basalt, brought from the mountains of Ethiopia.

PAUSANIAS—ÆLIAN AND APPIAN.

In Pausanias the only notices in any way relating to our subject are an allusion to the silver mines of Laurium in the commencement of the Attics, and in the Laconics a statement that Eurotas diverted the river. In Ælian and Appian there is nothing except perhaps that the latter, in the account of the siege of Carthage, mentions a cut made through the harbour by the Carthaginians.

ARRIAN.

Arrian in his Life of Alexander, 7th book, chap. 21st, gives a better account than Strabo of Alexander's repair of the canal called Pallacopas, although this latter account differs, we shall content ourselves with a reference to it. We may observe that Gronovius has annexed to his edition of Arrian a small treatise on this canal, which embodies all the account and modern information respecting it.

In his second book Arrian devotes much space to the siege of Tyre, from which we shall extract some of his remarks on the mole. He says that the sea there has a clay bottom, and shallow towards the shore: but when you draw near the city, it is almost three fathoms deep. As there was abundance of stone not far off, and a sufficient quantity of timber and rubbish to fill up the vacant spaces, they found no great difficulty in laying the foundations of their own rampart; the stiff clay at the bottom, by its own nature, serving instead of mortar, to bind the stones together. The Macedonians showed a wonderful forwardness and alacrity to the work, and Alexander's presence contributed not a little thereto; for he designed every thing himself, and saw every thing done. In describing the subsequent operations Arrian says that many engineers, meaning military engineers, were brought from Cyprus and Phenicia.

In the fifth book a long account is given of the mode adopted by the Romans, and particularly by the old Romans, in forming temporary bridges for crossing large rivers.

The British Queen Steam-ship.—This splendid steamer sailed yesterday for Antwerp. A select party of gentlemen went in her on a visit to Belgium. The British and American Steam Company have, it is said, received for her the sum of £60,000 from the Belgian government. For the President the same company received above £70,000 from the underwriters. The losses sustained by the company since its establishment are supposed not to be less than £80,000 nor more than £100.000.—*Liverpool Albion, Sep. 6.*

ON THE MANUFACTURE OF BRICKS AND TILES.

[We are indebted for the following article to a very useful work by Mr. Aikin, just published; we have appended some additional notes, which we think will be found useful, and make the article more complete.—EDITOR.]

Till lately, bricks appear to have been made in this country in a very rude manner. The clay was dug in the autumn, and exposed to the winter frosts to mellow; it was then mixed, or not, with coal ashes, and tempered by being trodden by horses or men, and was afterwards moulded, without it being considered necessary to take out the stones. The bricks were burnt in kilns or in clamps; the former was the original mode, the latter having been resorted to from motives of economy. When clamps began to be employed I do not know: but they are mentioned in an act of parliament passed in 1726, and therefore were in use prior to that date. The following, in few words, is the present process of brick-making in the vicinity of London, for the practical particulars of which I am indebted to Mr. Deville and Mr. Gibbs.

It is chiefly, I believe entirely, from the alluvial deposits above the London clay, that bricks are made in the vicinity of the metropolis; and a section of these deposits generally presents the following series, such as would naturally result from a mixture of stones, and sand, and clay, and chalk, brought together by the force of water, and then allowed to subside. The lower part of the bed is gravel, mixed more or less with coarse sandy clay and pieces of chalk: this by degrees passes into what is technically called malm, which is a mixture of sand, comminuted chalk, and clay; and this graduates into the upper earth or strong clay, in which the clay is the prevailing or characterizing ingredient, the proportion of chalk being so small that the earth makes no sensible effervescence with acids. Bricks made of the upper earth, without any addition, are apt to crack in drying, and in burning they are very liable to warp, as well as to contract considerably in all their dimensions: on this account they cannot be used for the exterior of walls; and a greater number of such are required for any given quantity of work than of bricks, which, though made in the same mould, shrink less in the baking. The texture, however, of such bricks is compact, which makes them strong and durable. Bricks formed of this clay, whether mixed or unmixed, are called stocks; it was formerly used unwashed, and when the bricks were intended to be kiln-burnt, or *flame-burnt*, to use the technical word, no addition was made to the clay. If they were intended to be clamp-burnt, coal-ash was mixed during the tempering. Of these and all other clamp-burnt bricks the builders distinguish two kinds, namely, the well-burnt ones from the interior, and the half-burnt ones, or place bricks, from the outside of the kiln.

The calcareous clay or malm earth requires no addition of sand or chalk, but only of ashes. The bricks made of it differ from those made of the top earth, in being of a pale or liver brown colour, mixed more or less with yellow, which is an indication of magnesia. The hardest of the malm bricks are of a pale brown colour, and are known by the name of gray stocks; those next in hardness are called seconds, and are employed for fronts of the better kind of houses; the yellowest and softest are called cutters, from the facility with which they can be cut or rubbed down, and are used chiefly for turning the arches of windows. What I have said of top earth and malm earth must be understood, however, to refer to well-characterized samples of these varieties, but, as might be expected, there are several brick-fields that yield a material partaking more or less of the qualities of both, and therefore requiring corresponding modifications in its manufacture.

Brick earth is usually begun to be dug in September, and is heaped rough, to the height of from four to six feet, on a surface prepared to receive it, that it may have the benefit of the frost in mellowing it and breaking it down. It is then washed by grinding it in water and passing it through a grating, the bars of which are close enough to separate even small stones. The mud runs into shallow pits, and is here mixed with chalk ground with water to the consistence of cream, if any calcareous ingredient is required. When it has become tolerably stiff by drying, coal ashes (separated by sifting from the cinders and small pieces of coal) are added, in the proportion of from one to two and a half inches in depth of this latter to three feet of clay, the most tenacious clay requiring the greatest quantity of ashes. The ingredients are then to be well mixed; and, finally, the composition is to be passed through the pug-mill,* in order to complete the mixture

* The pug-mill is an iron cylinder set upright, in the axis of which an arbor or shaft revolves, having several knives, with their edges somewhat depressed, projecting from it and arranged in a spiral manner round the arbor. By the revolution of the arbor the clay is brought within the action of

and to temper it. The moulder stands at a table, and the tempered clay is brought to him in lumps of about 7 or 8 lb.: the mould is a box without top or bottom, $9\frac{3}{4}$ inches long, $4\frac{3}{4}$ wide, and $2\frac{3}{4}$ deep; † it lies on a table: a little sand is first sprinkled in, and then the lump of clay is forcibly dashed into the mould, the workman at the same time rapidly working it by his fingers, so as to make it completely close up to the corners; next he scrapes off with a wetted stick *(strike)* the superfluous clay, throws sand on the top, and shakes the brick dexterously out of the mould on to a flat piece of board, *(a pallet board)* on which it is carried to a place called the hacks formed of the new bricks, into open hollow walls, which (in wet weather) are covered with straw to keep off the rain; here they dry gradually, and harden till they are fit to be burnt. A raw brick weighs between 6 and 7 lb.; when ready for the clamp it has lost about 1 lb. of water by evaporation.* A first-rate moulder has been known to deliver from 10,000 to 11,000 bricks in the course of a long summer's day, but the average produce is not much more than half this number (1).

The price of bricks varies from forty to sixty shillings a thousand, of which not more than one shilling and three pence a thousand, at the utmost, can be the cost of moulding, assuming the average work of a moulder to be five thousand in a day; any improvement, therefore, calculated to save time in this department of brick-making by the introduction of machinery worked by steam, or by horse power, can only amount to a benefit equal to a fraction of one thirty-second or one forty-eighth of the entire price of the commodity. If we assume such machine to produce fifty-two million bricks in a year, this amounts to two millions a week (for the season for brick-making in this country continues no longer than from April to September inclusive) or three hundred and thirty thousand in a day, equal to the labour of sixty-six men or eleven horses, without making any allowance for friction, or any deduction on account of temporary repairs. The cost of hand-moulding fifty-two million bricks at one shilling and three pence per thousand is 3250*l.* from which, if we deduct the first cost and repair of machinery, the expense of fuel or of horses, of superintendence, &c. it would probably be found that nothing would remain for profit.

Bricks are burnt either in kilns or in clamps (2). In the former the burning is completed in twenty-four hours; in the latter it requires from twenty to thirty days, but is on the whole cheaper, notwithstanding that the loss from over-burning, from under-burning and other accidents amounts to one-tenth of the whole number of bricks (3).

The consumption of London is for the most part supplied from the brick-fields that surround it in all directions, the principal of which, however, are situated north of the Thames, at Stepney, Hackney, Tottenham, Enfield, Islington, Kingsland, Hammersmith, Cowley, Acton, and Brentford. Those made at Grays Thurrock, Purfleet, and

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the knives, by which it is cut and kneaded, and finally is forced through a hole in the bottom of the cylinder.

* A malm brick of the above dimensions will shrink by burning to the length of 9 or $9\frac{1}{4}$ inches. A brick made of top clay without any mixture of chalk, will often shrink to $8\frac{1}{2}$ inches.

† From some experiments made in France we learn the following particulars:—A mould 8 inches 3 lines long, 4 inches, 3 lines broad, and 2 inches 2 lines thick, yielded bricks which on an average weighed, when first made, 5 lb. 14 oz. When dried and ready for the kiln they weighed 4 lb. 8 oz. having 22 oz. of water; 9 oz of this quantity evaporates in the first twenty-four hours, the other 13 oz. require five or six weeks to evaporate. By burning, 4 oz. more of volatile matter is driven off; a well-burnt brick of the above dimensions weighing 4 lb. 4 oz. A fresh-burnt brick when laid in water absorbs about 9 oz *i.e.* from one-seventh to one-eighth of its weight.

It appears, however, from experiments by M. Gallon, that the weight of bricks varies according to the care with which the clay is worked or tempered. Some clay was well worked, and then beaten for half an hour, on the morning of the next day it was again worked and beaten as before, and in the afternoon was again beaten for a quarter of an hour, and was then made into bricks. Another parcel of bricks was made of some of the same clay, treated in the usual manner. Both parcels were dried in the air for thirteen days, when it was found that those made by the former process weighed on an average 5 lb. 11 oz. each, while those made by the latter weighed 5 lb. 7 oz. Both kinds were burnt together for ten days; they underwent no relative change in bulk, but the weight of the former was 5 lb. 6 oz. and of the latter 5 lb. 2 oz.—*Arts et Metiers*, vol. iv.

(1) The operation of making the bricks is generally undertaken by one man called the moulder, who with his wife, children, and one or two men, form a gang. One of the gang, a man, wheels the soil to the pug-mill; after it is tempered it is removed by a boy or girl from the pug-mill to the *banker*, (the moulder's work-bench), it is then kneaded by a woman, who passes it to the moulder next to her, and as fast as the moulder turns the bricks out of the mould, they are removed by a boy on to the off-bearing barrow, which is wheeled to the drying-ground by 1 or 2 men, who set up the bricks in the hacks in a slanting direction, two in width, and about two inches apart, and 3 feet high: these hacks run the whole length of the drying ground and are placed in parallel lines 4 to 5 ft, apart. When the bricks have stood a few days they are reset with a greater space between them, which operation is called *scintling*, and in about a week after, they are removed to the clamp or kiln.—Ed. C. E. & A. Jour.

(2) A clamp is formed first by raising the earth a few inches above the natural surface of the ground to an uniform level; some of the hardest of the new made bricks, or, if there be any in the field, some old bricks previously burnt are set on edge over the whole site of the intended clamp, which are to prevent the moisture of the ground penetrating the new made bricks. Flues are then formed by the bricks being laid side by side, with a small space between to the height of 3 feet and about 9 inches wide: the top is covered by bricks being set off on each side, until they form an arch or covering; these flues run the whole length of the clamp, and generally about 6 feet apart; they are filled with furze or dry faggot wood, over which are laid small sea coal, or breeze (cinders), the intermediate spaces are filled in with bricks (this operation is termed *crowding*) laid a short distance apart, and between each course a layer of breeze is laid and repeated the whole height. The upper courses are laid a little closer than the lower ones, as they receive a greater proportion of heat, the outside of the clamp is generally closed in with place bricks (half burnt or soft bricks), and the top covered with breeze and sometimes earth; when the clamp is made up the fuel in the flues is ignited, which communicates with the breeze laid between each course, and shortly the whole of the clamp is in a state of combustion, and becomes one mass of fire, communicating with the ashes contained in the bricks; part of the exterior is sometimes coated with clay to prevent the cold winds penetrating. As soon as the whole of the clamp is properly ignited, the flues are closed, when particular attention is required to prevent the fuel burning too fiercely or too slowly. If it burn or draw too quickly on either side, screens are placed on the outside to check the draught. When the whole is properly burnt, which is in about 25 or 30 days, the clamp is partially opened and allowed to cool; the bricks are then sorted, those which are properly burned are called *stocks*—if they are not sufficiently burned they are of a pale red colour and soft, called *place bricks*—if the fire has acted too fiercely, several of the bricks will be vitrified into one solid mass, which are called *burs*. The whole operation of making bricks from the time the earth is turned into the pug-mill to the time the clamp is open, averages about 6 weeks.

The kiln is of an oblong form, brick built, with one opening in the end or side, and generally 13 feet long, 10 ft. 6 in. wide, and 12 feet high; and will contain about 20,000 bricks, the walls, on the top, are about two bricks thick, and at the bottom three bricks; they are built battering (inclining) inwards, the bottom is covered with narrow recesses arched over with openings left in the top, having the appearance of lattice work, in these recesses is deposited the fuel, on the top the bricks are laid with spaces between to allow the fire to pass up: the upper courses are laid a little closer than the lower ones, and the surface covered over with old brick or tile rubbish to keep in the heat and prevent the rain damaging the upper bricks; when the kiln is full, some wood is put in and ignited, to dry them thoroughly: when this is done, which is known by the smoke becoming transparent, the mouth of the kiln is closed with old bricks and covered with clay, leaving sufficient space for faggot; brushwood, furze, bavins or dry faggot wood to be put in and lighted. The fire being made up it is continued till the ashes assume a whitish appearance, and the flames appear through the top of the kiln, the fire is then slackened and the kiln cools by degrees. The process is continued, alternately heating and slackening till the bricks are thoroughly burned, which is generally in the space of 48 hours. The advantages of kiln burning is the greater certainty in the operation and shortness of time in burning, which is done in about two days, whilst the operation of clamp burning occupies frequently 30 days. The bricks are generally of a bright and sometimes dark red colour.—Editor C. E. and A. Journal.

(3.) The following are the prices for the several operations in brick making:—

DIGGING PER CUBIC YARD.	*s.*	*d.*
To digging the uncallow, including wheeling not exceeding *one run* (a run is three 20 feet planks placed in a continuous line, lengthways)	0	4
Digging and wheeling brick earth	0	4
Turning and soiling (mixing sand or ashes with the brick earth	0	$2\frac{1}{2}$

MAKING, PER THOUSAND.		
Making the bricks, including the tempering of the clay, molding, and hacking (stacking)	4	0
Scintling (removing and restacking the bricks in the hacks)	0	$2\frac{1}{2}$
Crowding (placing) the bricks in the clamps or kiln	1	$4\frac{1}{2}$
Two yards of clay or brick earth (which will make one thousand bricks) digging and soiling at $6\frac{1}{2}$*d.* per yard	1	1
Wear and tear of tools (found by the master) and keep of horse	2	0
One-fifth of a chaldron of ashes for soiling, at 5*s.* per chaldron	1	0
One-fifth ditto of breeze for fuel, 7*s.* 6*d.* ditto	1	6
Straw 6*d.*, sand 6*d.*	1	0
Kiln or clamp expenses for attending to open it, leading carts, &c.	1	0
Duty	5	10
Rent	2	0
£1	1	0

To the above must be added the expenses for removing the uncallow, risk, losses, interest on capital sunk, &c., and if washed the additional labour and cost of chalk, &c. Stock bricks average at this time about 30*s.* to 32*s.* per thousand, in the field, and place bricks 24*s.* The price to the latter is almost prime cost, consequently a greater profit must be allowed on the stocks to cover all losses, which in wet seasons are very serious. The duty is obliged to be paid on the quantity in the hack, notwithstanding any part or the whole may be damaged or destroyed by wet weather or in process of manufacture; for these risks government allow 10 per cent., reducing the duty to 5*s.* 3*d.* per thousand on the quantity made before burning.—Ed. C. E. & A. Jour.

Sittingbourne, are of a very good quality and a fine yellow colour; stone-coloured ones are made near Ipswich, and have been largely employed in the outside walls of some of the new churches of the metropolis. At Cheshunt, in Hertfordshire, is a bed of malm earth of the finest quality, no less than twenty-five feet in depth: from this are made the best small kiln-burnt bricks, called paviers. They are hard, absorb very little water, and are used for paving the floors of stables, wash-houses, &c. They have entirely superseded the use of Dutch clinkers, which formerly were imported from Holland in large quantities. The red sandy bricks called Windsors are made at Hedgerley. There is a considerable exportation of bricks from London; many being sent to the West Indies, to Quebec, and to other colonies.*

Tiles, from the purpose to which they are applied, namely, roofing houses in order to shoot off the rain, require a texture as compact as can be given to them, consistent with a due regard to economy. The fattest and most unctuous clays are, therefore, those which answer the best, especially if free from gravel and the coarsest sand. The price of tiles, compared with that of bricks, is such that the manufacturer can afford to dry them under cover; while, being not more than one quarter of the thickness of bricks, the drying is more speedily performed, and with far less hazard of warping or cracking: the same also is the case with the baking. Sand is added to the clay, but sparingly; for if, on the one hand, it prevents the ware from warping, yet, on the other hand, it increases the porosity, which is a fault especially to be avoided. The general manipulations of grinding the clay and tempering it are analogous to those already described for making bricks; but more pains are bestowed in getting it to the utmost degree of plasticity so as to allow of its being rolled, like dough, into cakes of a proper thickness, which are afterwards brought to the required shape by pressing them into a mould.

* The whole number of bricks made in Great Britain and Ireland in the year 1835, on which the excise duty was paid, was 1380 millions.

ON THE PERCUSSIVE ACTION OF STEAM.

Our correspondent C. S. in the last number of the Journal has taken an observation which we made in the first part of our article on this subject in the August number in a wrong light; nor should we have expected him to have attached so much importance to that observation after reading the rest of the article, from which he would have seen that, if we thought it unfair of Mr. Parkes to attribute all the advantage of percussive action to Cornish engines, and none to others, we also considered the amount of that advantage to be equal to nothing, which we think clearly demonstrated by our reasoning: so that we cannot exactly be of opinion that Mr. Parkes *favours* the Cornish engines, simply by considering that the percussive force of steam is only developed in them. The remark that this force should be developed in a greater degree in Locomotive engines does not necessarily imply that it should be developed favourably; for, by reason of the lead given to the slide valve in those engines, the steam is first let on to the back of the piston, and its percussive force would therefore tend, as our correspondent justly observes, "to impede the engine, if not stop it altogether."

The rest of our correspondent's remarks, since they have for object "to show that the Cornish single-acting engines are the only ones at present in which the percussive force of steam could act with any very great advantage, and that the locomotives are the very worst in which it could be used as a motive force," and thus suppose the fact of its advantageous action in the former to be already established beyond all question, cannot be regarded as an answer to our article above mentioned, but merely to the single remark already alluded to, and to which he has, as we have shown, attributed a meaning we never intended it to convey. It is difficult to assign a reason for his replying to the least important portion of our article, and passing over the main argument in silence.—Is it that he considers the question of the propriety of applying the principle of Percussion to the action of the steam as above discussion?—This was not very reasonable, since he has, so far as we are informed, the authority of but one writer, the infallibility of whose theories has not hitherto been established by experience; in proof of which, see the Count de Pambour's paper *On Momentum proposed by Mr. Josiah Parkes as a Measure of the Mechanical Effect of Locomotive engines*, and our Reviews of Mr. Parkes' paper on the same subject, in the Journal of last year, page 102. We must, however, assume this to have been our correspondent's motive for abstaining from any discussion of the principle of the percussive action of steam, as otherwise we should be reduced to the alternative of either supposing that he did not understand the reasoning by which we demonstrated, or attempted to demonstrate its fallacy, or that he followed Paddy's plan of beginning at the end. Be this as it may, the following remarks may perhaps induce C. S. to modify his opinions in some measure.

He observes that, "in a common double-acting rotative engine, where the steam is let into the cylinder when the crank is just passing the centre, it is evident that any percussive force of the steam striking upon the piston could not by any means have any effect in turning the crank." But he states farther on that "the action of this force is avoided in this case, as well as in that of the Locomotive engine, by the gradual motion of the slide, for as soon as the slide begins to open the steam way, the steam rushes into the cylinder, and strikes upon the piston, but with very little effect, on account of its being so much wire-drawn in consequence of the small size of the opening at first." It would naturally be inferred from this latter observation that our correspondent supposed the percussive action of the steam to be confined to the moment when the valve begins to open, in other words, that it is only *the first portion* of the steam which has any percussive action, and that this action is communicated instantaneously to the piston the moment that portion of steam passes through the valve; which, if it were true, would obviate the development of percussive action in Cornish single-acting engines as well as in those above mentioned; for the steam valve of a Cornish engine, though opened more suddenly than the slide valve, is nevertheless not opened instantaneously, but more or less gradually. If, on the other hand, we assume the development of this action to occupy some time, however brief, so as to allow of the opening of the valve of the Cornish engine, (which is equally necessary for the double-acting rotative engine), then must we also admit, not only that there is percussive action in the latter as well as in the former, but also that this action must assist in turning the crank, which will have passed the centre before it has ceased to operate.

We do not agree with C. S. in the opinion that "in order to render the percussive force of steam available to its fullest extent as a moving power in single-acting pumping engines, it would be necessary to have some medium interposed between the direct action of the steam on the piston and the pumps; so as to convert the ever-varying pressure on the piston into a regular and steady pressure on the plunger of the pump;" for the condition of a constant pressure on the pump bucket, is by no means indispensable, as the effect of a diminution of pressure on the steam piston, supposing such medium not to exist, would be simply a corresponding diminution of the velocity, or of the acceleration of the bucket and column of water, which would by no means affect the application of the percussive force of the steam. This column of water is, however, considered by C. S. as a medium interposed between the direct action of the steam on the piston and the pumps, which is curious enough, since the action of the steam works the pumps, and these raise the column of water.

We cannot make out that our correspondent's remarks have in any degree shown, as he supposes, "that in the Cornish engine we might use the percussive force of steam as a moving force to a very considerable extent;" for such negative evidence as that which he reproduces from Mr. Parkes' paper, viz. that the duty performed by those engines is greater than he could otherwise account for, cannot be admitted as rigorous. What is required of the supporters of Mr. Parkes' opinions is a *direct* proof that in Cornish or any other engines, the steam develops a power, by means of percussion, *in addition to* that measured by its elastic force, without which it is idle to enter into any discussion respecting the comparative fitness of different kinds of engine for the development of this additional power.

ON THE POWER OF THE SCREW.

We have received a letter from Mr. J. R. Cussen, in defence of the views set forth by him in a communication published in our Journal for May last, and which were partially refuted by a correspondent in the July number. We cannot insert this letter, since it is evident that the writer is in error on all points; but for his information, and the information of any other persons who may be led into error by his arguments, we shall point out clearly in what his mistakes consist, and how they have probably arisen.

As to his first objection to the theory laid down by the Rev. Mr. Bridges, our July correspondent alluded to above is undoubtedly right with regard to the meaning of d, which signifies the *height* of the inclined plane, or distance between the top of one coil of the thread of the screw and the top of the next, which is the distance through which the resistance is moved in one revolution of the screw, and is called the *pitch* of the screw: it could not possibly signify, as understood by Mr. Cussen, the distance from the upper side of one coil of the thread to the under side of the next, as that would admit of an infinite number of different solutions to the problem of finding the power necessary to overcome a given resistance, according as the ratio of the thickness of the thread to the interval between its coils might be more or less, which circumstance could not effect the result, since it is only the upper side of the thread, or that which is in contact with the resistance, which sustains the resistance. Mr. Cussen may, therefore, rest satisfied that all theorists agree with him in substance, if not in expressions.

Respecting his second objection, Mr. Cussen has overlooked the chief part of the theory of the *lever*, and, unless he objects to that theory also as now taught by *all* authors and professors without exception, the following reasoning will convice him of his error.

We will take his examples of the three screws, each of ½ inch thread, which, converted into intelligible mechanical language, is one inch pitch, and of 3, 6, and 9 inches diameter respectively, worked by a lever of 90 inches long, the lever moved by a windlass of one ton power. But it is necessary first to understand clearly what is meant by a lever 90 inches long. In mechanical language its signification is the distance in a straight line from the fulcrum (which is in the axis of the screw) to the point of application of the power, which does not, however, seem to be the meaning attached to the expression in Mr. Cussen's second letter; he seems rather to mean the distance from the *surface of the cylinder* to the point of application of the power, which is not the true measure of the power of the lever: we shall therefore take the liberty of understanding it in the former sense. This being premised, suppose for a moment that no lever is used; we shall have, by Mr. Cussen's, as well as by Mr. Bridges' formula:

in the first case $1 : 3 \times 3{\cdot}1416 :: 1 : w = 9{\cdot}4248$ tons,
in the second case $1 : 6 \times 3{\cdot}1416 :: 1 : w = 18{\cdot}8496$ tons,
in the third case $1 : 9 \times 3{\cdot}1416 :: 1 : w = 28{\cdot}2744$ tons.

Now the power is applied in the first case at a distance of 1½ inch from the fulcrum, in the second at 3 inches, and in the third at 4½ in. distance; so that, by applying it at a distance of 90 inches in all three cases, we shall obtain the following results respectively:

in the first case $1\frac{1}{2} : 90 :: 9{\cdot}4248 : w = 565{\cdot}488$ tons,
in the second case $3 : 90 :: 18{\cdot}8496 : w = 565{\cdot}488$ tons,
in the third case $4\frac{1}{2} : 90 :: 28{\cdot}2744 : w = 565{\cdot}488$ tons,

or the pressure independent of the diameter of the screw, which overthrows the second objection.

Mr. Cussen's third objection falls to the ground with the preceding, indeed it has no meaning at all; for he *virtually* multiplies by the circumference of the circle described by the extremity of the lever when he multiplies by the circumference of the screw and by the length of the lever, although he omits to divide by the semidiameter of the screw, as he ought in that case to do, and as it will be seen, on an inspection of the above calculations, we have done to obtain the final value of w. If we take the first case, we had finally

$$w = \frac{1 \times 3 \times 3{\cdot}1416 \times 90}{1 \times 1\frac{1}{2}},$$

and it is obviously the same thing whether we suppose 3·1416 to be first multiplied by 3, to give the circumference of the screw, and the product to be afterwards multiplied by 90 the length of the lever, and divided by 1½ the semidiameter of the screw, as above, or whether we suppose 3·1416 to be first multiplied by *twice* 90, to give the circumference described by the extremity of the lever, and as the factor 3 of the numerator is essentially twice the factor 1½ of the denominator, these two factors disappear. Or, to make it still more apparent, let r represent the radius of the screw, d its pitch, l the length of the lever (measured from the axis of the screw), P the power and w the resistance. Then the last equation would be

$$w = \frac{P \times 2\,r \times 3{\cdot}1416 \times l}{d \times r}$$

from which it is evident that, if we take the 2 from the factor $2\,r$, and multiply it by the two factors 3·1416 and l, we shall obtain the circumference described by the extremity of the lever, or by the power; and this product, multiplied by $P \times r$ will obviously be the same as if the product $2\,r \times 3{\cdot}1416$, which is the circumference of the screw, were multiplied by $P \times l$. But Mr. Cussen has committed the error of leaving out the factor r in the denominator, forgetting that when no lever is used, the power is applied at the circumference of the screw, and that the leverage is equal to r, so that when the leverage is increased to l, the resistance is increased in the ratio $\frac{l}{r}$. Having demonstrated Mr. Cussen's error, and shown its probable origin, we may now cancel the r in the numerator and denominator of the fraction, and it will remain

$$w = \frac{P \times 2\,\pi\,l}{d},$$

π being the ratio of the circumference of a circle to its diameter

If Mr. Cussen's remark "that one-third of the calculated power is lost by friction," is meant to bear upon the comparison of the effect of screws of different diameters but the same pitch, it will be found on investigation that the friction bears no fixed ratio to the resistance, but increases in a slightly greater ratio than the diameter of the screw, and thus gives a proportionate advantage to screws of small diameter.

ON THE ECONOMY OF FUEL IN LOCOMOTIVES CONSEQUENT TO EXPANSION AS PRODUCED BY THE COVER OF THE SLIDE VALVE.

Sir—Having observed several errors in Mr. J. G. Lawrie's calculations, published in your useful and interesting Journal for August last, allow me to point them out for the benefit of your readers.

I should premise that the formulæ he has given for the several distances travelled by the piston: from the commencement of the stroke to the commencement of expansion, from the commencement of the stroke to the opening of the eduction port (not to the end of expansion, for expansion continues, but more rapidly, and the effect during the rest of the stroke is not to be neglected), and from the commencement of the stroke to the position of the piston when the valve opens for the lead of the next stroke, are correct. I should however observe that the expressions under the radical sign in the values of a' and c' are identical, and may be reduced to $(1-c^2)\,[1-(l+c)^2]$; and perhaps it would be better if the expressions $(1 - l\,c - c^2)$ and $(1 + l\,c + c^2)$ in the same two values were written respectively

$$[1 - c\;(l + c)\;] \text{ and } [1 + c\;(l + c)\;].$$

The errors I have discovered are in the computation of the effect, which follow.

Mr. Lawrie finds the volume of steam of the initial pressure p admitted during the stroke to be equal to $s\left(a' - \frac{(2\,d - b)\,t}{p}\right)$, (at least I suppose this expression to have been meant by the writer, although the factor s is omitted and h is printed instead of p in the denominator,) which is a sufficiently near approximation, but I cannot comprehend how he can make this quantity equal to $2\,d \times 1$, although he observes with truth that the quantity of fresh steam must (whatever the expansion is) be constant; but a constant quantity is not necessarily an arbitrary one, as which it might be considered in this case, for we may give s any value we please, and it would follow that the quantity of steam used per stroke would be the same, whatever the area of the piston might be, provided the length of stroke, lead and cover of the slide were the same. And if we supposed the area of the piston $s = 1$ square foot (a reasonable hypothesis), the factor 1 in the expression $2\,d \times 1$ signifying (as I suppose) also 1 square foot, we should necessarily have $a' - \frac{(2\,d - b)\,t}{p} = 2\,d$, which is impossible, for $a' \angle\; 2\,d$. His expression of the value of s is therefore incorrect; besides it is obviously impossible to deduce the area of the piston from the length of stroke, cover and lead of the slide, and ratio of the greatest to the least pressure in the cylinder, without knowing how much steam is generated in the boiler.

Secondly, the effective working pressure during the expansion is found $= \frac{a'\,p}{x} - t$, x expressing the distance travelled by the piston from the beginning of the stroke; and this expression will give too great a value by 3 or 4 lb. per square inch, if not more: for t is used to express the least pressure of the steam in the cylinder, which it has at the moment when the eduction port is closed, and which probably scarcely exceeds the atmospheric pressure, and the mean resistance of the waste steam amounts to 4 or 5 lb. per square inch. Besides this, the formula given to express the quantity of work done during the portion b of the stroke makes no allowance for the diminution of temperature consequent on expansion; but this may be too slight to be of any consequence, as the expansion is inconsiderable in locomotives; nor is any allowance made for the waste space which has to be filled with steam. But the effect during the rest of the stroke is not to be neglected, that is, from the moment when the eduction port is opened to the termination of the stroke; for, on account of the very small opening of the port during that period, very little steam is enabled to escape, and it had previously been but slightly reduced in pressure by expansion, so that its mean pressure during this last portion of the stroke will bear a considerable proportion to its initial pressure, and cannot therefore be neglected. On the other hand, the effect of the compression of the spent steam of the pressure t, between the instant of shutting the eduction valve and that of opening the steam valve, is so small that it might much rather be disregarded; for it commences with a pressure of about 1 atmosphere and terminates with about 1·4, say on an average $\frac{1}{4}$ atmosphere through one-fortieth part of the stroke, or about one-tenth of a lb. through the stroke, due to compression.

Thirdly, Mr. Lawrie makes the inexplicable assumption that the safety valve be so loaded that $p = s$—the initial pressure of the steam in atmospheres = the area of the piston!—Supposing the square foot to be the unit of area, and $s = 1$ square foot: we should then have $p = 1$ atmosphere, and the engine would not move; but if the square inch were the unit of area, for the piston of the same size as before we should have $s = 144$ square inches, and consequently $p = 144$ atmospheres!—These results show the manifest absurdity of the supposition.

Lastly, the values of a', b and c', in the examples which close the paper, are not determined correctly from the formulæ which, I said above, are themselves correct, so that the whole paper requires revision and correction, except the first part, as I have explained.

Hoping that the above remarks may be found serviceable to your readers,

I remain, &c.,

M.

MR. JOSIAH PARKES IN REPLY TO COUNT DE PAMBOUR

Mr. Editor—M. de Pambour has recently repeated, in several of the weekly and other periodicals, certain virulent strictures on my writings. I am at a loss to conjecture on what grounds that individual should have indulged in these, as well as in his earlier, and nearly similar, attacks upon me. I have, hitherto, declined replying to them, and for two reasons; first, I did not wish to convict a man of M. de Pambour's celebrity of deliberate misrepresentation; nor, secondly, to expose, more publicly than he had himself done to persons really conversant with the steam engine, his lamentable ignorance of practical matters. But, his resumption of these attacks, in the present form, renders it incumbent on me to be no longer silent. I, therefore, avail myself of the same medium of communication, and shall confine my reply to the exhibition of one instance of his gross ignorance, and of one instance of his numerous, and injurious, falsifications of my opinions and writings.

Every engineer is acquainted with the *cataract*, an instrument nearly as old as Newcomen's engine, and used for the purpose of opening the steam induction valve, and thus starting an engine, after any required period of rest. This species of water clock is also occasionally employed to open other of the valves at definite times. The Cornish engineers appreciate its value, not only as a means of regulating the number of strokes to be made by a pumping engine, in a given time, but also as effecting the influx of steam into the cylinder in the most instantaneous manner. Neither they, nor any other engineer ever, probably, imagined the cataract to exercise an influence over the *production of steam* in the boilers of their engines. The Comte de Pambour, however, ascribes to the instrument this miraculous virtue, in the following passage:

"We will finally remark that it is customary in these engines to make use of the *cataract*. Under this circumstance the engine does not evaporate the full quantity of water, that its boiler would otherwise be capable of evaporating per minute; but, on introducing into the formulæ the evaporation really effected, the formulæ will always give the corresponding effects of the engine."—(*New Theory of the Steam Engine. J. Weale*, 1839, *chap.* xi., *Cornish Single Pumping Engine, p.* 278.)

This *is*, verily a *new theory*. No observations of mine are requisite to illustrate the absurdity of theories, and formulæ, emanating from a person who is so little practically versed in the mechanism, and auxiliary apparatus of an engine, as to jumble together, and confound, in one paragraph, the distinct functions of the *cataract*, the *boiler*, and the *engine*.

In a later work, M. de Pambour has devoted no less than 16 pages of introductory matter to a criticism of my Paper on the Locomotive Engine, (published in the Transactions of the Institution of Civil Engineers, vol. iii.), in which, among others, I had occasion to examine his own experiments. In that paper not a word will be found disrespectful of M. de Pambour; his sentiments are treated with courtesy; and, at the risk of being thought tedious, I prefaced each of my observations on his conclusions with a quotation of the matter commented upon. M. de Pambour's reply contains numerous misapprehensions of my meaning, and arguments, of which I do not complain; but every author has fair ground of complaint against the antagonist who perverts his text; who invents arguments for him; or who cites, as authentic quotations, phrases which he never employed. In no one instance has M. de Pambour quoted my own words; in lieu of which he has frequently invented words and opinions for me. The following extract affords a concise example of the veracity and style of the 16 pages of criticism.

"The want of using equations which facilitate so much accuracy in mathematical reasoning *(and the author accounts for it in telling us that he is more accustomed to handle his hammer than his pen,)* causes him to heap errors on errors, combining and complicating them unaware, till he arrives at a point where he does not produce a single result that is not erroneous."—(*A Practical Treatise on Locomotive Engines*, 2nd edition. J. Weale, 1840. *Introduction*, page xxxiii.)

The paragraph in italics is a pure invention. No such words even occur in my paper as *hammer* or *pen*.

The writer who resorts to the miserable tactics of falsifying the language and opinions of one who differs from him on subjects open to large controversy, exhibits a consciousness of inferiority in his arguments, which it would have been wiser, and far more manly to acknowledge, than to attempt to conceal, by expedients so unworthy, and so certain of detection. Such a man may, possibly, be a skilful mathematician, but he cannot claim rank among *philosophers*, whose sole objects are the discovery and propagation of *truth*. I consider myself exonerated from all obligation to reply, in greater detail, to an adversary who descends to such ignoble practices; but justice to my own reputation requires that I should expose them to public reprobation. This I do with the more regret as I have derived both instruction and pleasure from some parts of M. de Pambour's researches.

I remain, Sir, your obedient servant,

Josiah Parkes.

12, *Great College-street, Westminster*,
September 13, 1841.

LONG AND SHORT CONNECTING RODS.

Sir—In your September number there are two communications animadverting on my paper on connecting rods in the July number. In this paper, my object was to establish the soundness of the connecting rod, *in general*, as a medium of moving force, and thereby to endeavour the settling of the controversy about long and short rods. For it is not disputed by any, I presume, that the strains and consequent friction between moving parts, in machinery, occasioned by connecting rods on the same crank, are in a certain proportion to their lengths; and I agree that herein longer rods have the advantage of shorter. But the question has been, whether, purely as transmitters of force, the former has any superiority to the latter, which leads to the question whether generally and abstractly, connecting rod motion is just as a medium of force. As I have said, it was my object to prove the affirmative of the question. Therefore, in this view of the subject rods of different lengths to the same crank ought to be one in effect.

Though certainly I did not notice the fact, I was aware that the connecting rod would not work on a crank of the same length in the usual style. We may mention, however, that a modification of this case is in fact practised in epicycloidal motion, a demonstration of which is given in March number for last year, in which the stroke of the piston is twice the throw of the crank, and the radius of the inner wheel is the connecting rod.

I am, Sir, your's, obediently,

D. Clark.

Glasgow, September 16, 1841.

Artesian Well at Grenelle.—M. Mulot, in some of his recent experiments at the Artesian well in the abattoir of Grenelle, succeeded in forcing the jet of water as high as 63 feet above the ground, and when it reached this height, the water assumed a bell shape, ten metres in diameter, which produced the most picturesque effect. Unfortunately the water continues muddy: therefore, though there is a certainty of being able to procure nearly 2000 litres of water in the course of a minute, at a height which admits of its being conveyed into the highest stories of the houses in Paris, it is not yet known to what purposes the water can possibly be applied.

EPISODES OF PLAN.

(Continued from page 290.)

THE breaks and interruptions occasioned by our "Episodes" being given to the reader piecemeal in monthly portions, are attended with no injury to our essay, and with some convenience to ourselves, by in some measure concealing abruptness of transition from one subject to another, and by enabling us to avail ourselves of such pauses, in order to bring such incidental remarks as we may deem expedient. Such being the case, we venture again to remind our readers that the plans here presented to them, are intended merely to furnish ideas in respect to form and arrangement: for, as we ourselves are perfectly aware, they would require to be more or less modified, in order to adapt them according to the other—and to us, of course, unknown—circumstances attending any given case. For more frequently than not, probably, it would be considered necessary to retrench and simplify them, to consult effect less and economy more. Accordingly there is very little danger of their being borrowed from in so direct a manner, that application of them would be tantamount to plagiarism, more especially, as hardly any two persons would produce the same design from the same plan.

Should any one be of opinion that those here produced might be greatly improved upon as regards further development of the ideas contained in them, great would be our satisfaction at finding any of them so turned to account, or otherwise corrected and matured. It is possible, however, that a very different construction may be put upon our motives, and that it will be thought to betray somewhat too much of self-complacency, if not of arrogance, on our part, to suppose that our suggestions can be of any value to other persons. Such presumption, if presumption it be, we, of course, partake in common with all who publish designs of their own; but with this difference, that while they give entire plans of houses, as if they were so many perfect models in every respect, we merely throw out partial hints, without presuming to dictate any further. In so doing, we of course leave it to be inferred that we think sufficiently well of our ideas as to imagine they may possibly prove serviceable to others, and of the two, it is surely less offensive to suppose that architects can have occasion for any promptings of such kind, than that they can at all require studies for the arrangement of ordinary houses, or can obtain fresh instruction from plans which are, for the greater part, of the most familiar and every-day character.

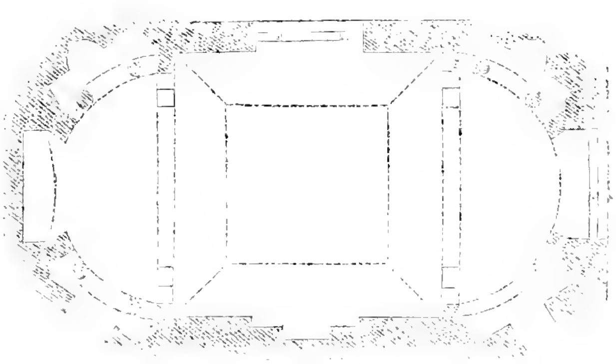
On the other hand, it may fairly be urged against ourselves and our Episodes, that the latter manifest too much straining after novelty and architectural display; that no regard is paid in them to economy, and that, in fact, they are applicable to general purposes, nor at all likely to suit the taste of persons in general. This is too true for us to attempt to contradict it: we leave persons in general, be they architects or those who employ them, to adhere to the present jog-trot system, taking no thought or study in regard to effects arising out of plan and varied combinations, but satisfying themselves that every thing in regard to plan is accomplished, provided that the number of rooms of the dimensions required be obtained, and mere convenience sufficiently attended to, which last, however, is far from being invariably the case, where the plan is only divided into so many squares and parallelograms.

It is not the least ill consequence of all attending the routine system we would fain break through and abolish, that by excluding variety of form in plan, it likewise excludes what would else suggest fresh ideas in regard to style of fitting up, and decoration. Most undoubtedly much character may be given to a room of the simplest and most usual form, yet it is seldom done, and seems to be as seldom attempted. On the contrary, there is a certain established uniform into which rooms of the same class are put almost indiscriminately, without regard to other circumstances. This is more particularly the case with regard to dining-rooms, for which it seems to be laid down as a rule that they have as little architectural attraction as possible bestowed upon them, in fact, show little more than plain walls of a single tint. As a general rule this is, we admit, a wholesome and safe one enough, because, if it admits nothing to gratify, it excludes much that might offend the eye. The very monotonousness and plainness are, besides, characteristic in themselves, so far as such a room is thereby sufficiently distinguished from the others in a house. Still, equal distinction, we conceive, could be kept up, equal propriety of character be maintained, with far greater variety of design; because simplicity and sobriety are by no means restricted to any one mode in particular; neither is the same degree of them desirable upon every occasion. What in one case would be modest elegance, may in another prove scarcely better than chilling nakedness and monotonous dulness. Where all else is plain and unpretending, an air of quiet homeliness and even snugness is becoming enough; but where plate is profusely displayed, and all the appointments of the table are of a sumptuous kind, some corresponding degree of show in the room itself can hardly be an inconsistency. Not only cheerfulness, but festivity of appearance will be perfectly in character, care of course being taken that the particular character be distinctly in accordance with the particular purpose of the room itself. Some variety of colouring is admissible, and though we would exclude *pictures*, we would freely admit *paintings*, that is of a light decorative cast, and as subsidiary to architectural character, such as borders and narrow upright panels at intervals, with arabesques or single figures *en camaieu*, or on a marbled ground. But as to oil pictures in frames, we consider them very ill-suited for dining-rooms, notwithstanding that they are frequently to be met with in them, and are almost the only decorations that are. As far as effect goes, the frames are of more importance than the pictures themselves, which, let them be ever so worthy of examination, are not likely to obtain it, unless attention be pointedly directed to them. Oil pictures are much better adapted for morning than evening rooms; since, so far from at all showing themselves to advantage by artificial light, many of them rather give a room a sombre though rich appearance at such time, unless the room happens to be lighted up expressly for the purpose of exhibiting the pictures themselves.

But all this while we are forgetting our "Episodes," or rather our main subject, and indulging in lengthy episodical remarks grafted upon it, and from which we will now make a transition by quoting an example of a dining-room that was certainly a frequent architectural episode in the interior of Carlton House, we mean the circular one on the principal floor, for the "Gothic" dining-room at the east extremity of the lower apartments towards the gardens, was a positive monstrosity—almost as vile and trumpery in taste as can be conceived. The other was an octastyle Ionic rotunda, extended by four deep recesses or alcoves radiating to the centre of the plan, consequently expanding inwards. We are not aware of any thing similar having been done in any other room of the kind; and yet not only is the plan exceedingly beautiful in itself, but one that admits of numerous variations, to say nothing of the great diversity of design it allows and even suggests, in other respects.

By way of contrast to the plans we gave in the first instance, we now show one for a dining-room whose ends are concave and semicircular, but whose plan is of peculiar character, there being small recesses with columns, between which there is at one end of the room a third recess for the side-board, at the other a window. Any arrange-

Fig. 5.



ment of this kind would produce an unusual degree of architectural play and richness, with somewhat of intricacy, but not such as to produce confusion or disturb the regularity, if not simplicity, of the ensemble, since the individual parts and recesses are sufficiently connected together by the columns and antæ, disposed semicircularly.

The idea itself admits of being so variously shaped, of being taken as the germ of so many distinct designs, not for a dining-room alone, but for apartments of other kinds, that were we at all at a loss for subjects, we could make it serve us for a great many Episodes. For instance, supposing the plan to admit of it, the same arrangement would be exceedingly well adapted for a library or morning-room with a window at each end, the four recesses, either with or without columns, being filled up with bookshelves, and either a single door opposite the fire-place, or two doors in the angles on that side of the room as circumstances might require. Else there might be a window there as at present, and three recesses for book-cases at each end of the apartment

In regard to the plan here shown as that for a dining room, it is not proposed as one capable of being strictly followed, because it would stand in need of more or less alteration in order to adapt and adjust it, so as to combine advantageously with the rest. Of course it is here presumed that there is nothing to hinder its being executed precisely as it is represented in the cut. The door near the sideboard is supposed to open into a corridor communicating with the offices, and the other from a vestibule or ante-room, as the case might be. There are four pedestals for candelabra, and there might be others in the two arches within the recesses: these, however, are not absolutely essential to the design, but might be adopted or omitted according as more or less decoration should be held desirable,—a point to be regulated by the scale of embellishment fixed upon. The recesses and semicircular ends of the room are supposed to be floored with ornamental tiles or mosaic (like the saloon of the Reform Club), and the square or centre part to be covered with a rich carpet. Or else the whole might be carpetted, and the same kind of distinction be nevertheless kept up, by putting down plain carpetting of some quiet neutral tint at the ends, for the purpose of giving more importance to the middle compartment of the room, and to the two extreme ones somewhat the air of being spacious semicircular alcoves with smaller recesses within them. After all, however, the propriety of so doing would depend upon whether any corresponding sort of distinction between the several divisions of the room was observed in the design of the ceiling. Should the situation of the room be such as to admit of the centre being lighted from above, the ceiling might then be raised by a cove, and have a lantern occupying the rest of it. In such case no side windows would be required, still the one at the end of the room might be retained, unless it should be preferred to make a second sideboard recess corresponding with that at the opposite end, or to have these folding doors opening from an ante-room, substituting a niche for the present door in the recess on the left hand.

(To be continued.)

ON THE FORMS AND PROPORTIONS OF STEAM VESSELS.

Though reluctant to call in question the opinions of so able a writer as "H. P. H." appears to be, I think he has no authority for multiplying the "sectional *area* of the immersed parts" of a steam vessel, into the (mean) *depth* below the surface of the water, in order to find the resistance to her motion. Doubtless this would be correct for "flood-gates," of which one surface only is exposed to the water, and the pressure is that arising from the *weight* of the fluid; but the case of a vessel is totally different, the resistance arising not from any weight of the fluid, (for the pressure on the after half of the vessel tending to push her forward, is exactly equal to the pressure on the fore part which tends to retard her,) but from a species of friction and from the inertia of the fluid. This resistance probably increases in porportion to the *density* of the water, not to its *depth*.

As the whole of the theoretical part of the article "On the Forms and Proportions of Steam Vessels," is founded on the presumption that the resistance is proportional to the section and depth, instead of section without regard to depth, as given in mathematical works, and as it will be completely erroneous if the above view is the correct one, it may be worth while for H. P. H. to reconsider the nature of the resistance of which he writes, and to favour the readers of the Journal with his opinions—waiting which I am,

Very respectfully,

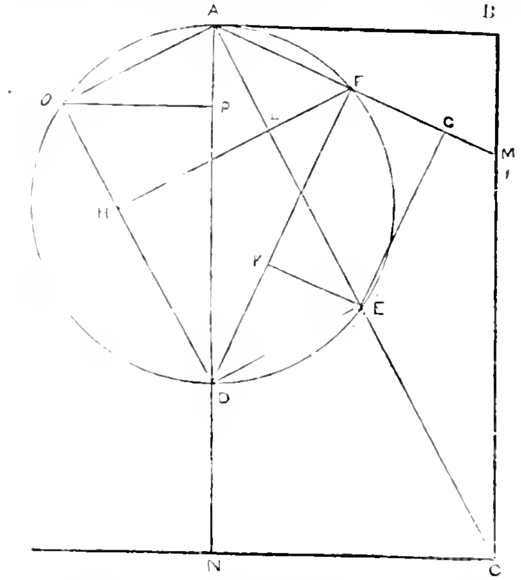
A. M.

Neath, 11th of 9th month, 1841.

ON THE STRAIN OF BEAMS.

Sir—It may be interesting to trace the effects on beams of strains acting on them in a parallel direction. In the common hand punch, for example, there is an upright beam bent at right angles at top to a convenient distance, the extremity being fitted to receive the reaction of the plates under the punch. Here the strain on the beam is upward. Instances of similar downward strains, too, are familiar, as in some portable balances, in which the scales hang from the extremity of an upright standard bent forward at the upper end.

Let A B C be an upright standard rising perpendicularly from the sole N C. and bent at right angles at B; let it be subjected to a force



acting downwards in the line A N parallel to B C. Then it would appear on a general view, that the part B C will be equally affected throughout, as the force, which let A D represent, has the same leverage on all points of B C.

But, more particularly, in estimating the action of the force on any point M, we may consider it as acting on M by the imaginary straight lever A M. The action of the force A D on M may be analysed by drawing D F perpendicular to A M; A D = A F and F D, the former being longitudinal pressure along A M, the latter, a lateral strain on the cross section at M by the leverage A M. Similar resolutions for other points in B C will form right angled triangles on the common base A D, and thus the locus of the vertices of these triangles is a circle described on the diameter A D, passing through point F, of course.

To ascertain how the forces A F, F D, acting on the section M, affect any other section, as that at the base C, draw A C cutting the circle at E, join D E, and complete the parallelogram O E; draw F H perpendicular to O D, cutting A E and O D at L and H. Then A F = A L and L F, and F D = D H and H F, these four resultants all acting at point A on lever A C; the sum of the longitudinal strains is A L + H D = A L + L E = A E; the lateral strains L F and F H, acting in opposite directions = F H — F L = H L = D E. Thus the resultants of the forces A F, F D, acting on the section M, are A E and E D on section C. But A E and E D are also the resultants of A D acting directly on section C. It appears, then, that the effect of the force A D on the section C is one, whether acting directly by A C, or indirectly by A M C. Again, the reciprocal action of the forces A E, E D, acting directly on C, upon the section M, may be had by drawing E K, E G perpendicular to D F, A M respectively. For we then have D E = E K and K D, and A E = A G and G E. Then G E or F K + K D = F D, and A G — K E or F G = A F. But A F and F D are the resultants of A D acting directly on M. Therefore, as M and C represent every two points in B C, and as the direct action of the force A D on either point is identical with its indirect action through the other point, we conclude, generally, that its action on every cross section of B C is constant, and therefore B C ought to be of equal dimensions from bottom to top. Draw O P perpendicular to A D, then A O = A P and P O, and D O = O P and P D, and as P O in these two quantities acts in opposite directions, we have A O and D O = A P and P D = A D, which intimates that there is no lateral thrust on the standard, so that the cross section of B C may at once be determined from the quantities A D, N C. The part A B ought to have the parabolic outline, modified when the corner B is rounded.

By supposing all the forces reversed in direction, the above demonstration will apply also to standards subjected to upward strains.

I am, Sir,

Your obedient servant,

Daniel Clark.

Phœnix Iron Works,
Glasgow, 20th Aug.

P. S. I think it would be a great improvement to introduce symbols to express the most common terms in papers of the nature of the preceding: ○ for *circle*, ⊥ for *perpendicular*, &c.

COMPETITIONS.

Sir—While I regret to find that so very little good, if any at all, should hitherto have been produced by all that has been said on the subject of Architectural Competitions, I am glad to perceive that you are not backward in aiding to correct the abuses now attending the present mode of conducting them.

The case stated in your last number is perfectly scandalous and flagitious, that were not the circumstances given upon Mr. Godwin's own authority, I should conceive it to be unfairly reported. And yet when I consider what sort of a design it was to which the highest premium was awarded in the first competition for the Royal Exchange,—a design that would be now utterly forgotten—had not that circumstance rendered it so memorable; when, again, I consider the result of the two competitions for the Nelson Monument, and that nothing more tasteful and original than the stale absurdity of an overgrown column could be picked out of all the designs and ideas submitted to the Committee, I am less astonished than I else should be at the *measures* which, it appears, have been taken by the "Tailors."

After especially inviting seven architects to make selection of the poorest design of all, certainly does look most awkwardly suspicious. Still, in this instance, I should say that the "honourable" Committee have perhaps done no more than act up to the very letter of their engagement, bestowing the prize on him who displayed *Superiority*—though it happened to be that of demerit.

It is some little consolation to reflect that such very flagrant instances may in time have the good effect of stiring up the profession to unite cordially and vigourously in devising such measures as should in future protect them from such swindling,—and to give it, would be almost to countenance it. Any sort of delicacy towards persons who scruple not to lend themselves to such dirty doings, would be sheer weakness. Better would it be were the names of all the parties—all the "highly respectable" individuals, concerned in such transactions, shown up to the public. A little pillorying of that kind would do a vast deal of good, and serve to render such respectable gentlemen either a little more cautious or a little more adroit. If they must be rogues there is no occasion for them to show themselves such arrant bunglers also, as they now generally do.

I remain, &c.

Vindex.

Sir—Eventually the evils arising from the present system of public and limited competitions will work their own cure, as architects who love their profession and desire to uphold its respectability will pause ere they lend themselves to the gross jobbing, and party interest which so generally occurs on such occasions. It seems to me that as a body we are heaping insult upon our own heads by the submission of designs (generally—if not always—the result of mature deliberation), to men seldom possessing an atom of architectural taste, or any other qualification requisite to render them efficient as judges of the works placed at their disposal for acceptance or rejection. I would advise my friend Mr. Godwin to keep an eye upon the Tailors he alludes to in your last number, (page 310), as no doubt they have been at their usual dirty work, and have "cabbaged" portions from each of the designs entrusted to their care; with regard to the Paddington Church job I happen to know very little about it, but should think, if all we hear is true, that for the credit of the Committee, "the least said is the soonest mended."

Having myself done with public competition, I may be permitted to add my opinion that architects competing should do so only upon the understanding that members of their own body should be their judges, as regards the comparative architectural merit and fitness of the several designs, and the more fairly to do so I would suggest that each candidate in turn should examine and compare the designs, and omitting his own, should give in a written opinion upon their several degrees of excellence; the decision thus come to could hardly fail in being a just one, while by this means the first, second and so forth would be pointed out without any chance of favouritism, and each of the judges having in his own case been compelled to study the whole work minutely, he would thus be the better qualified to give an opinion upon the productions of others; this proposal no body of persons advertising for designs could reasonably object to, if they wish to have erections throughout the land, which are to remain monuments of the talents of their respective architects, and of their own taste in expending the means committed to their disposal.

The success of some of the profession, who (like itinerant vendors of tea, millinery, &c.) scour the country in the various directions pointed out by the public advertisements, and earwig the Committees, may induce them for a time to follow up competition as a thriving trade; but I feel assured such a system cannot last, it only requires those architects who honour their profession, to unite in upholding its respectability, by refusing to enter into any competition unless it is regulated in some equitable and consistent manner, and in the long run they must succeed. The two last competitions that I had any thing to do with were the Infant Orphan Asylum and the Tower of Wandsworth church, at the first the architects were limited to 20,000*l.* as about the sum to be expended, and in order that this stipulation should be attended to, all the parties competing were required to furnish detailed quantities of their several designs, in defiance of this stringent clause, which of course sate like an incubus upon the ideas of the greater number who sent in—a design was chosen, the lowest tender for the execution of which was about 33,000*l.*; in this case two premiums were offered, one of 100 guineas and one of 50 guineas, the second of which only was awarded, thus: those who conformed to the printed regulations were excluded from participating in the first premium, while those who did not reaped the whole benefit; and I maintain that the Committee were bound in justice to those who obeyed the instructions, to have awarded both premiums, if to please themselves they chose to execute a more expensive design.

In the second case, namely, that at Wandsworth, the present Tower of the Church being in a very dilapidated state, the parish deemed it necessary that something should be done, and the result of their deliberations was that architects should be invited to send in plans, &c. for a new Tower, to cost 1,000*l.*, which sum they were willing to expend: but lo! when the designs came before them, they, contrary to the above case, considered economy to be the order of the day, and they in consequence awarded their premium to a design to cost 500*l.* only, and thus again those who conformed were laid on their backs, but it did not rest here, for after their economical decision in came the *extreme* economists of various denominations unconnected with the church, and at a subsequent meeting decided on curtailing the edifice of its intended fair proportions, by actually carrying a resolution to repair the already condemned and ruinous old Tower, at a still less expense; but the tables are turned, the work (I am given to understand) is stopped, the builder is afraid to proceed, and the architect refuses or rather suspends any other opinion but that he is to complete his contract; thus the parish are literally in a pretty situation between two stools, and have no one to thank but themselves. While from the want of rule in competitions as shown in the above cases, the profession never have any guarantee that their productions will be judged by any uniform and equitable rule, but find themselves put out of court sometimes because they are not sufficiently gorgeous, and sometimes because they are too expensive, while in both cases they have strictly conformed to the instructions given.

I am, Sir, your obedient servant,

John Burges Watson.

39, *Manchester Street, Manchester Square,*
September 7, 1841.

Sir—Reading in your valuable Journal for this month, some curious statements respecting "Competition Designs." I beg to state a case which happened to me some time since at Shrewsbury, which I think will surpass, in richness of facts, any I have yet read about.

A premium of 10*l.* was offered, publicly, for the best plan of a chapel to be erected near the town of Shrewsbury. The vestry were to be the judges.

They met at the publicly advertised time, and selected my design, and their officer informed me of the fact.

Not hearing any thing more about the matter for some time, I called at the vestry-room, and inquired how things were going forward.

And, Sir, what do you think was the answer I received, from the same functionary who had previously charmed my heart by giving the information previously stated? A cheque for the 10*l.* was—*not* handed over; nor was any order from the vestry given for me to proceed with the work. But still—"something" was given me which astounded me equally with either, and that was a grave address from the aforesaid officer, in the following words:—They have now given the premium to ———.* My feelings were of course those of surprise and astonishment, and almost *disbelief*; but the latter was soon expelled on receiving from my informant the *reasons* which actuated the "vestry." "The fact is this, Mr. —— assured some of our vestry that if they thought proper to give the premium to him, he would hand it over to one of the town charities, and they thought as how they could not commit a a nobler hact." This you will say *was* a noble act.

Your's, truly,

Veritas.

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* An architect who lived in the town and parish.

NEW ACTS OF PARLIAMENT.

There have been introduced, by Lord Normanby (the late secretary of state) into the Houses of Parliament, three very important Bills connected with the profession, which demand their immediate and especial attention. The bills are too long to be transferred entirely into our Journal, but we shall give an abstract of the most important clauses in each Bill, which will show their general character.

REGULATION OF BUILDINGS IN LARGE TOWNS.

Abstract of a Bill intituled "An Act for regulating Buildings in large Towns," which has passed the House of Lords, and is now before the House of Commons.

1. Whereas disease is engendered and aggravated by the crowded and unhealthy manner of building the dwellings of the working classes in the large towns and populous places of this realm, and it is expedient to make provision for improving such dwellings: be it therefore enacted, &c., That the council of every borough which is within the provisions of an act passed in the sixth year of the reign of his late Majesty, intituled "an Act to provide for the Regulation of Municipal Corporations in England and Wales," or of any charter granted in pursuance of that or any subsequent act, and of every borough which is within the provisions of an act passed in the fourth year of the reign of her Majesty, intituled "an Act for the Regulation of Municipal Corporations in Ireland," and the magistrates and councils of every royal burgh and parliamentary burgh in Scotland, and of every burgh of barony or of regality in Scotland under the government of magistrates and councils, and also in England and Ireland the justices of the peace in general or quarter sessions assembled, and in Scotland the sheriff, having jurisdiction in any other town or place which her Majesty, with the advice of her privy council, shall order to be within the provisions of this act, shall, within six calendar months next after the passing of this act, or next after such order, and from time to time as vacancies shall happen, appoint a fit person, or so many fit persons as the council or justices or sheriff respectively shall think fit, not being surveyors of the estates of the mayor, aldermen, and burgesses of any borough, or of the corporation of any burgh, in which they are appointed, to be surveyors of buildings in such borough, town, or place, and to see that the several provisions of this act are observed therein; and each of the said surveyors shall have in his special charge such district of the borough, town, or place for which he is appointed as the council or justices or the sheriff shall in that behalf appoint; and each of the said surveyors shall hold his office during the pleasure of the council or justices or sheriff by whom he is appointed, and may, if the council or justices or sheriff shall so think fit, but not otherwise, have an assistant or assistants under him (such assistants being in all cases appointed by and holding their situations during the pleasure of the council or justices or sheriff); and the council or justices or sheriff shall have authority to fix the districts in which the said surveyors are to act within the borough, town, or place, and to do all things relating in anywise to the appointment and direction of such surveyors and assistant surveyors: provided always, that if a charter of incorporation shall be granted to any town or place in which such surveyors or assistant surveyors have been appointed, the future appointment of such surveyors and assistant surveyors shall be vested in the council, as if such town or place were incorporated at the time of the passing of this act.

2 and 3 enacts, that surveyors are to make declaration, to diligently, faithfully, and impartially perform the duties of the office; the council or justices or sheriff shall provide an office for the said surveyors.

4, Surveyors to be paid by fees, not exceeding for a first rate building 3*l.* 10*s.*, second rate 3*l.*, third rate 2*l.* 10*s.*, fourth rate 2*l.*, fifth rate 1*l.* 10*s.*, sixth rate 1*l.*; and for every alteration or addition to any building, a sum not exceeding half the above.

5, Powers given to councils of boroughs by this act to be exercised in Oxford by commissioners under act 11 G. 3, for improving the city of Oxford.

6, The surveyors appointed under any of the acts specified in the schedule (London, Bristol and Liverpool), shall be the surveyors for enforcing so much of this act as is to be enforced within the limits of the said several acts, and shall be entitled to receive for their trouble herein such additional fees as shall be ordered and settled by the authority by which they are appointed.

7. Notice of building or altering premises to be left at the surveyor's office.

Clauses 8 to 15, regulations for fees, duties of surveyors, penalties for default of notice, workmen offending and refusing inspection.

16, That it shall not be lawful to build within the limits of this act any house in which the floor of any room or cellar to be used as a dwelling* shall be below the surface or level of the ground in the immediate neighbourhood of such house, unless there shall be an open area not less than three feet wide from the floor of such room or cellar to the top of the area adjoining to the front or back of such room or cellar, and extending from one side or party wall to the other side or party wall; but this enactment shall not be taken to prevent any archway or covering which may be laid across such area for the purpose of approaching the doorway of the house.

* We consider that the words here used require to be particularly defined if they mean any room that is used for domestic purposes, such as a kitchen forming part of a dwelling house, the act will then effect a very serious injury on nearly half the houses in London: if dwelling mean a room wherein any person sleeps, then we do not see any objection to the Act, but in such case it would be better to alter the word *dwelling* to *sleeping room*.—Editor.

17. That in any house to be built within the limits of this act after the passing thereof it shall not be lawful to let separately, except as a warehouse or storehouse, or to suffer to be occupied for hire as a dwelling place,* any underground cellar or room not having a window and fireplace, as well as such an open area adjoining thereunto, as is herein-before specified.

18. Enacts, that in any house built within the limits of this act before the passing thereof it shall not be lawful to let separately, except as a warehouse or storehouse, or to suffer to be occupied for hire as a dwelling place, after the first day of January 1845, any underground cellar or room not having a window, or after the first day of January 1848, any underground cellar or room not having, in addition to such window, such an open area not less than two feet wide, as is herein-before described, or after the first day of January 1851, any underground cellar or room not having a fireplace in addition to such window and area.

19, Enacts, that every person who shall wilfully let or suffer to be occupied any underground cellar or room contrary to the provisions of this act shall forfeit and pay the sum of 20*s.* for every day that such cellar or room shall be so occupied, to be recovered by action of debt, either by the person occupying such cellar or room, or any other person who will sue for the same.

20, Enacts, that on any *new foundation* within the limits of this act it shall not be lawful to build any house, except corner houses, and houses built in a street or thoroughfare which was begun or laid out, before the passing of this act, under the authority of any act of parliament, unless there shall be a clear space of at least 20 feet wide between the back wall of such house and the back wall of any opposite house: provided always, that in estimating this distance no account shall be taken of any back addition or outbuilding belonging to either of such houses not more than half the height of the back wall of the house above the level of the street, and which addition or outbuilding shall not extend along more than two-thirds of the whole width of the house to which it belongs; but no such addition or outbuilding shall be nearer than seven feet to any other house, or to any addition or outbuilding to any other house, except privies, sheds, or other buildings, not more than eight feet high above the level of the street which may adjoin the fence or fence wall on either side.

21, Enacts, that it shall not be lawful to build any new street, alley, or public passage within the limits of this act, except such as were begun or laid out before the passing of this act, under the authority of any act of parliament, unless the houses therein shall be separated by at least 30 feet where there is a carriageway between such houses, or at least 20 feet in the case of alleys and foot passages where there is no carriageway.

22, Enacts, that it shall not be lawful to build within the limits of this act any new court or alley (except mews and stable yards) narrower than 30 feet, through which there shall not be an open passage at each end thereof at least 20 feet wide, and entirely open from the ground upwards.

23, Enacts, that the level of ground floor of every house which shall be built within the limits of this act shall be at least six inches above the level of the footway or road adjoining such house.

24, Enacts, that no room which shall be built within the limits of this act to be used as a dwelling on the cellar or ground floor, or elsewhere than in the upper story of any third rate house, or any house of a lower class or rate than the third, as defined by the said several acts named in the schedule (London, Bristol and Liverpool), within the limits of the said acts respectively, and elsewhere as defined by this act, shall be less than eight feet in height from the floor to the ceiling, and no room in the upper story of any such house shall be less than seven feet in height from the floor to the ceiling.

25, That there shall not be more than one story in any part of the roof of any house or other building which shall be built within the limits of this act.

26, That no third rate or lower rate of house, defined as aforesaid, except houses in a street or thoroughfare which was begun or laid out, before the passing of this act, under the authority of any act of parliament, shall be built within the limits of this act without an enclosed yard, which, exclusive of any buildings therein, except the privy (if any), or any shed or other building not more than eight feet high, shall be of the extent of one-sixth part at least of the ground covered by the house; and no house shall be built within the limits of this act without a privy, with proper doors and coverings to the same, either in the house, or in the yard attached to the house, and sufficiently screened and fenced from public view, to the satisfaction of the surveyor of the district.

27, All buildings erected contrary to this act to be abated.

28, Provides for preventing neglect or evasion of this act.

29, And whereas it is expedient that further provisions for security against fire should be made in such boroughs and towns as aforesaid which are not within the provisions of any of the acts named in the said schedule (London, Bristol and Liverpool); be it enacted, that all buildings begun to be built or rebuilt in any such borough or town not within the provisions of one of the said acts shall, after the passing of this act, be built and rebuilt according to the regulations herein-after contained, and the outer walls, party walls, separate side or end walls, chimney backs, and chimney flues shall be built according to the schedule (A.) annexed to this act: provided always, that where there is more than one story below the level of the street the walls of the lowest story shall be half a brick or four inches and a half thicker than is otherwise required.

The remainder of the clauses apply to provincial towns, and are framed somewhat similar to the Metropolitan Building Act. The annexed schedule explains the thickness of the walls and the classes of buildings.

SCHEDULE (A).

DESCRIPTION OF BUILDINGS.	THICKNESS OF OUTER WALLS.				THICKNESS OF PARTY WALLS.*				
	In Cellar Story to under side of Ground Story Floor.	In Ground Story to the top of joists in floor above Ground Floor.	Above to the top of the Wall, or, if a Parapet, to the upper side of the ceiling of the Top Story.	Parapet.	In Cellar Story to under side of Ground Story Front.	In Ground Story to the top of joists in floor above Ground Story.	Above to the top of joists in floor above First Story.	Above to under side of the ceiling of the Top Story.	Above through the roof to the Top.
First Rate. Every Church, Chapel, and other Place of Public Worship, Brewery, Distillery, Manufactory, Warehouse and other Building (not being a Dwelling House or a Building in the Fifth or Sixth Class) which is higher than 31 feet. Every Dwelling House which is higher than 50 feet, or which contains more than nine squares of building on the Ground Floor—every Dwelling House or other Building which has more than three clear stories above ground.	2 B. or 17½ In.	2 B. or 17½ In.	1½ B. or 13 In.	1 B. or 8½ In.	2½ B. or 22½ In.	2 B. or 17½ In.	2 B. or 17½ In.	2 B. or 17½ In.	1½ B. or 13 In.
Second Rate. Every Warehouse or other Building (not being a Building in the First, Fifth, or Sixth Class, or a Dwelling House,) which is higher than 22 feet, or which has three clear stories above ground. Every Dwelling House (having three clear stories and no more above ground) which is higher than 40 feet, and every Dwelling House which contains more than five and not more than nine squares of building on the ground floor.	1½ B. or 13 In.	1½ B. or 13 In.	1 B. or 8½ In.	1 B. or 8½ In.	2½ B. or 22½ In.	2 B. or 17½ In.	2 B. or 17½ In.	1½ B. or 13 In.	1½ B. or 13 In.
Third Rate. Every Warehouse and other Building (not being a Dwelling House or a Building in the first, second, fifth, or sixth class,) which is higher than 13 feet, or which has two clear stories above ground. Every Dwelling House (having three clear stories and no more above ground) which is higher than 37 feet. Every Dwelling House which contains more than three squares and a half and not more than five squares of building on the ground floor.	1½ B. or 13 In.	1½ B. or 13 In.	1 B. or 8½ In.	1 B. or 8½ In.	2 B. or 17½ In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.
Fourth Rate. Every Warehouse and other Building (not being a Building in the first, fifth, or sixth class,) which is not higher than 13 feet. Every Dwelling House (having two clear stories and no more above ground) which is higher than 25 feet. Every Dwelling House which has not more than one clear story above ground, or which does not contain three squares and a half of building on the ground floor.	1½ B. or 13 In.	1 B. or 8½ In.	1 B. or 8½ In.	1 B. or 8½ In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.	1 B. or 8½ In.

Fifth Rate.

Every Building (not being a Building of the first class or a Dwelling House) which is at least four feet and not more than ten feet from any Public Street, Road, or Way, and at least sixteen feet from any other Building not in the same possession, or connected with any such Building only by a fence or fence wall, may be built of any dimensions, but must be built either of brick or stone, or covered with incombustible materials.

Sixth Rate.

Every Building, not in the first class, which is at least ten feet from any Public Street, Road, or Way, and at least thirty feet from any other Building not in the same possession, or connected with any such Building only by a fence or fence wall, may be built of any dimensions and with any materials.

* Separate Side or End Walls between Buildings shall not be less than the length of one brick or 8½ inches thick, or, when the wall is higher than 24 feet, less than the length of one brick and one half, or 13 inches thick.

Where any Building is not founded on rock, every Outer or Party Wall shall have at least four footing courses below the level of the Cellar floor, each two courses projecting 2¼ inches on each side of the course or wall immediately above them; and all Inner Walls shall have at least two footing courses 4½ inches wider than the wall above them; and all such footings shall commence upon a firm natural or artificial foundation to be approved by the Surveyor.

DRAINAGE BILL.

Extracts from a Bill intituled "An Act for the better Drainage of Towns and Villages," which has passed the House of Lords, and is now in the House of Commons.

1. WHEREAS there is great need of sanatory regulations in the towns and populous places of this realm, especially for want of sufficient means of drainage, whereby disease is engendered and aggravated; be it therefore enacted, &c., that after the passing of this act it shall not be lawful to build any house within the limits of this act, unless a drain be first constructed to the satisfaction of the commissioners of sewers having jurisdiction there, of such material, size, level, and fall as they shall direct, which drain shall lead from the intended site of such house to such common sewer, common drain, or common watercourse as the commissioners shall direct, or if there be no such common sewer, common drain, or common watercourse within 10 yards of any part of the intended site of such house, then to such cesspool or other place as the commissioners shall direct, not more than ten yards from some part of such intended site.

2. That in all cases where any house built within the limits of this act, either before or after the passing thereof, shall not be drained by a sufficient drain communicating with some common sewer, common drain, or common watercourse, to the satisfaction of the commissioners of sewers, and if a sewer, drain, or watercourse of sufficient size, under the jurisdiction of the commissioners of sewers, and which they shall think fit to be used for draining such house, shall pass along any public thoroughfare or way in front of or behind any part of such house, it shall be lawful for the said commissioners to give notice in writing, signed by any surveyor or officer appointed by them for that purpose, to the occupier of such house, requiring such occupier or the owner thereof forthwith, or within such reasonable time as shall therefore be appointed by the said commissioners, to construct a covered drain of such materials, size, level, and fall as the commissioners shall direct, from the said house to the said sewer, drain, or watercourse; and if the owner or occupier of such house shall refuse or neglect, during 28 days next after the said notice shall have been delivered to such occupier or left at such house, to begin to construct such drain, or shall thereafter fail to carry it on and complete it with all reasonable despatch, it shall be lawful for the said commissioners to construct the same, and to recover the expences to be incurred thereby by distress and sale of the goods and chattels either of the owner or of the then present or any future occupier of such house as herein-after mentioned, by warrant under the hands and seals of six or more or the said commissioners.

3. That whenever any house shall be rebuilt within the limits of this act, the level of the lowest floor shall be raised sufficiently to allow of the construction of such a drain as is herein-before provided in the case of houses to be built after the passing of this act, and for that purpose the levels shall be taken and determined under the direction of the commissioners of sewers; and whenever any house shall be taken down as low as the floor of the first story, for the purpose of being built up again, such building shall be deemed a rebuilding within the meaning of this act.

4. The level of every new street, court, alley, and place which shall be made, and also the level of every street, &c. in which any new common sewer or common drain shall be made, shall be fixed under the direction of the commissioners of sewers.

5. The commissioners of sewers shall have authority, from time to time, as they shall see fit, to widen, deepen, embank, alter, arch over, amend, clean, and scour all or any of the sewers, drains, watercourses, sinks, vaults, cesspools, and privies within their jurisdiction, and also to cleanse, drain, amend, and abate all stagnant ponds and other nuisances whereby the health of the neighbourhood is or is likely to be affected, and to make new sewers, drains, sinks, cesspools, or vaults where none formerly existed, and also to make reservoirs, engines, sluices, penstocks, or any other works for better draining any place within their jurisdiction, in, under, or across all or any of the public ways, thoroughfares, or places within their jurisdiction, and, if needful, through and across all underground cellars and vaults which they shall find under any of the said public ways and thoroughfares, doing as little damage as may be, and making due compensation for the damage done to the owners and occupiers thereof; and in case it shall be found necessary, for completing any of of the aforesaid sewers or drains, to build, carry, and continue the same into and through any inclosed lands or other place, not being a public way, it shall be lawful for the said commissioners to build, carry, and continue the same into or through the said lands or other place accordingly, making due compensation to the owners and occupiers thereof; and all such sewers and other works and premises shall be at all times under the control, care, and management of the said commissioners, and of their surveyors and officers.

6. It shall be lawful for the commissioners of sewers, at their discretion, to abandon any common sewer or common drain running through narrow courts or alleys of houses or inclosed places, or through or under any place not being a public way, in all cases wherein a new common sewer or common drain shall be constructed, in any public streets, roads, or highways contiguous thereto, and capable of receiving the drainage of such courts, alleys, or inclosed or other places; and that upon such drainage being turned into such new sewer or drain the said commissioners shall not thereafter be obliged to maintain the sewers or drains so to be abandoned, but shall order the same to be filled up at their discretion, and that all branch drains communicating with any sewer or drain so to be abandoned shall be turned by the owners of the lands and tenements theretofore drained thereby into the new sewer or drain to be constructed instead of such abandoned sewers or drains, by making drains into such new sewers or drains, conformably to the regulations of the commissioners of sewers; provided always, that if such new sewer or drain shall not be brought within the distance of ten yards from the lands or tenements formerly drained by the abandoned sewer or drain, the cost of completing the branch drains beyond the length of 10 yards shall be defrayed by the commissioners of sewers.

7. Commissioners to give 28 days notice and provide a plan and section before making any new common sewer or common drain under this act, where no common sewer or common drain already existed, and before abandoning any old common sewer or common drain, and before abating any such nuisance as aforesaid.

10. That before making any drain or watercourse for the purpose of draining water directly or indirectly from any land or tenement into any common sewer, &c., and also before beginning to lay or dig out the foundations of any house therein, or to rebuild any house therein, 14 clear days notice in writing shall be given to the commissioners; such new drain or watercourse shall be made of such materials and workmanship, and laid at such level, as is provided by this act, and under such regulations as the said commissioners shall order.

11.* That it shall be lawful for the commissioners, or for their surveyor or such other person as they shall appoint, to inspect any drain or watercourse within their jurisdiction, and for that purpose *to enter at all reasonable times, by themselves, or their duly authorized surveyors, officers, and workmen, upon any lands and tenements, and also to cause the ground to be opened in any place they shall think fit,* doing as little damage as may be; and if such drain or watercourse shall be found to be made to the satisfaction of the commissioners, they shall cause the same to be closed and made good as soon as may be; and the expences of opening, closing, and making good such drain or watercourse shall be defrayed by the said commissioners out of the rates and assessments authorized to be made by them by the laws in force relating to sewers.

12. That all branch drains, *as well within as without the lands and tenements* to which they belong, and all watercourses used for drains, and all privies and cesspools, within the limits of this act, shall be under the survey and control of the said commissioners, &c., and shall be repaired and cleansed at the cost and charge of the owners or occupiers of the lands and tenements to which the same shall belong; and if the owner or occupier of any land or tenement to which any branch drain, watercourse, cesspool, or privy shall belong shall neglect to repair or cleanse the same in the manner required by the said commissioners, during 14 days after notice in writing for that purpose, signed by any such surveyor or officer, shall have been given to such occupier, or left upon the premises, it shall be lawful for the said commissioners to order such branch drain, &c., to be repaired and cleansed, and to levy and recover the costs and expences thereof by distress, &c., either of the owners or of the occupiers so neglecting to repair and cleanse the same.

21. Commissioners shall cause a map to be made of the district within their jurisdiction, on a scale not less than one inch to 400 feet, and to mark thereon the course of every common sewer, common drain, and common watercourse, and shall cause the same from time to time to be altered and amended; and such map, or a copy thereof, with the date expressed thereon of the last time at which it shall have been so amended, shall be kept in the office of the commissioners, and shall be open at all seasonable hours to the inspection of the owners or occupiers of any lands or tenements within the jurisdiction of such commission.

25. Where any common sewer or common drain shall be made by the said commissioners, under any public way where no common sewer or common drain formerly existed, the cost of making the same shall be borne, in the manner herein-after specified, by the several owners of the lands and tenements abutting on such public way on either side thereof, in proportion to the several lengths of frontage so abutting;† and it shall be lawful for the commissioners, when they shall have undertaken the construction thereof, to charge the said several owners with the cost of constructing a common sewer of the usual size‡ in the jurisdiction of the commissioners, to be paid by *five equal yearly instalments,* the first instalment being payable as soon after the completion of the work as the commissioners shall require the same.

26. And whereas by the laws in force relating to sewers the commissioners are empowered to lay separate and distinct rates, as occasion shall require, for every separate and distinct level, valley, or district within their commission, or for any part thereof, whenever they shall think fit to do so; be it enacted, that so much of the cost of making any common sewer or common drain above the usual size which shall exceed the charges herein-before laid upon the several owners of lands and tenements abutting on any public way, and also the costs of making those parts of any common sewer or common

* Clauses 11 and 12 contain very extraordinary powers, and such as are liable to be used with great abuse.—EDITOR.

† For corner houses there ought to be some provision, so as to make them chargeable for one frontage only, and not as is now the case for two frontages —EDITOR.

‡ We consider that the commissioners ought not to have the power for charging or enforcing in any case more than for what is considered in London as a *second size* sewer. If a *first rate sewer* be constructed, the extra price ought to be chargeable to the whole district drained by it, as provided in the following clause.—EDITOR.

drain which cannot be charged upon any particular owner of lands and tenements, and of widening or deepening any common sewer or common drain already existing, and of repairing and cleansing each common sewer and common drain when made, shall be borne by the owners of all lands and tenements within the level, valley, or district, or part thereof, for which such separate rates are made, wherein such common sewer or common drain is situated.

29. That, subject to the provisions herein contained, the instalments payable for making any common sewer or common drain, and all rates which the commissioners are empowered to assess and shall assess upon any lands or ments within their jurisdiction, shall be recoverable, if not paid, by distress, &c. either of the owner or of the then present or any future occupier of such lands and tenements.

30. No occupier of any land or tenement for a less term than from year to year shall be required to pay, more than the whole amount of rent which was due and payable from him at the time when the notice herein-before mentioned in each case shall have been delivered to him, or left upon the premises as aforesaid, or which shall thenceforth from time to time accrue and become payable by him, unless he shall neglect or refuse, upon application made to him for that purpose by or on behalf of the commissioners, truly to disclose the amount of his rent, and the name and address of the person to whom such rent is payable; but the burden of proof that the sum demanded of any such occupier is greater than the rent which was due by him at the time of such notice, or which shall have since accrued, shall lie upon such occupier.

31. In every case in which any tenant or occupier shall have paid any sum for making, repairing, or cleansing any common sewer, &c., or for making or repairing any branch drain, or any cesspool or privy, in respect of his occupation of such lands or tenements, he shall be entitled to deduct from his rent such part of the amount so paid by him as is herein-after specified; (that is to say,) if at the time of such payment he is a tenant for an unexpired term of 7 years, or any less term, he may deduct the whole amount paid by him; if for more than 7 years and not more than 14 years, he may deduct $\frac{4}{5}$ thereof; if for more than 14 years and not more than 21 years, he may deduct $\frac{3}{5}$ thereof; if for more than 21 years and not more than 28 years, he may deduct $\frac{2}{5}$ thereof; if for more than 28 years and not more than 35 years, he may deduct $\frac{1}{5}$ thereof; but if for more than 35 years, he shall not be entitled to deduct any part thereof: provided always, that any tenant under a lease containing a covenant for renewal thereof shall be deemed a tenant for the full term to which his holding may be extended under such covenant; and that every tenant for a term depending upon a life or lives shall be deemed a tenant for such absolute term of years as shall be of the same value as such contingent term, according to the government tables for the purchase of life annuities; and every lessor, being himself also a tenant or lessee of any lands or tenements, from whose rent any part of the amount so paid to commissioners shall have been deducted, shall be entitled in like manner to deduct from the rent payable by him to his lessor such part thereof as according to the provisions herein-before contained he would have been entitled to deduct from his rent had he paid to the commissioners as aforesaid the sum so deducted from the rent payable to him; and the receipt of the commissioners, or of their treasurer or clerk, duly authorized in that behalf, shall be in each case a sufficient discharge for so much of the rent as is hereby authorized to be deducted: provided always, that nothing herein contained shall be taken to affect any special contract between any lessor and tenant or occupier of any lands or tenements, whereby it is agreed that the tenant or occupier shall defray the charges of making, repairing, or cleansing all or any sewers, drains, cesspools, and privies belonging thereunto.

40. And be it enacted, that the limits of this act in England shall be the city of London; every place within six miles in a straight line from St. Paul, and also within the jurisdiction of any commission of sewers now in force for any part of the counties of Middlesex or Surrey, during the continuance of such commission; and also every place in England within the jurisdiction of any commission of sewers which shall be duly issued after the passing of this act, by letters patent, wherein it shall be expressly declared that such commission is issued in furtherance of the provisions of this act.

41. After the passing of this act it shall be lawful for her Majesty, &c., to issue commissions of sewers in furtherance of this act for any part of Ireland.

42. And be it enacted, that this act shall extend to Scotland, and shall include all royal and parliamentary burghs, burghs of barony and regality, and also all towns and villages in Scotland which her Majesty with the advice of her privy council shall from time to time order to be within the provisions of this act.

IMPROVEMENT OF BOROUGHS.

There is a Bill now before the House of Commons intituled "an Act for the improvement of certain Boroughs," which act is to grant powers for opening and widening close and narrow streets, alleys, passages and places therein, and for otherwise improving the town, such powers to be vested in the councils of such boroughs, under certain restrictions. The following clause is the most important, and explains when the council is empowered to take lands compulsory.

4. And be it enacted, that in any of the following cases the council shall be empowered, if they think fit, to take any lands which they shall require for the purposes of this act, with or without the consent of the several owners and other persons interested therein, subject nevertheless to the provisions for ascertaining and giving compensation for the value of such lands, and for the other purposes herein-after contained; (that is to say,)

1. When any such lands are needed for the purpose of opening a thoroughfare through any court or alley which is closed at either end:
2. When any such lands are needed for the purpose of widening any thoroughfare which is narrower than 20 feet:
3. When any such lands project 10 feet or more beyond the general line of the street:
4. When the council shall have agreed with the owners thereof for the absolute purchase of the lands on each side of the lands so required to be taken, the value of those already agreed for being at least 10 times the value of those not agreed for:
5. When any such messuages or tenements built before the passing of this act are contrary to the provisions of an act passed in this session of parliament, intituled "an Act for regulating Buildings in large Towns and Villages," and are not amended according to the provisions of the said act within six calendar months after notice thereof given by the council to the owner or occupier thereof:

Provided always, that it shall not be lawful for the council to take any such messuages, lands, or tenements, without the consent of the owners and other persons interested therein, unless with the approval of the commissioners of her Majesty's woods, forests, land revenues, works, and buildings.

NEW HOUSES OF PARLIAMENT.—VENTILATION, &c.

The following is a copy of the correspondence for the warming and ventilation of the two Houses of Parliament, laid before Parliament.

Office of Woods, Aug. 27, 1841.

Sir—The progress of the works at the new Houses of Parliament, and the necessity of laying down the foundations on which the flues for warming and ventilating the houses are constructed, induced me to desire Mr. Barry and Dr. Reid to make a joint report on these subjects, by which it appears that a sum of 86,000*l.* will be required for warming, ventilating, and securing the buildings from fire, according to the following statement:—

Ventilating tower		£20,000
Air and chimney flues in the walls		12,320
Apparatus		12,000
		£44,320
For securing the buildings from fire—		
Fire-proof floors under the roof	£20,680	
Brick floor on iron beams between the principal and upper stories	21,000	
		41,680
		£86,000

I must observe, that in this sum Mr. Barry has included the sum of 20,000*l.* for a centre tower, not intended in the original plan, but which will be so constructed as to suit Dr. Reid's new system of ventilation, which he considers will be a great addition to the beauty of the structure. I am unwilling to recommend so large a sum to the Treasury without the sanction of Parliament, although a considerable part will be necessary under any circumstances, if the houses are to be warmed and ventilated on the system adopted by Dr. Reid in the present temporary houses, and which appears to me to give general satisfaction.

From the prices at which contracts have been taken for the works already in progress, there can be no doubt, with care and attention, that a considerable saving will take place on the original estimate that was sanctioned by the committee of the two houses; and I therefore request you to bring the subject before the House of Commons, as the state of the works makes it necessary that some decision should be come to without delay; I will only add, that no unnecessary delay has taken place in bringing this subject forward, and that Dr. Reid has delivered in his estimate as soon as the state of the works allowed him to do so.

I have, &c.,

Duncannon.

The Right Hon. F. T. Baring, &c.

Westminster, Aug. 21, 1841.

My Lord—I beg to submit for your Lordship's consideration, a drawing of the river front of the new Houses of Parliament, showing the effect of a central tower of the height and diameter required by Dr. Reid for the purpose of ventilation, according to his first suggestion; and I have no hesitation in expressing my opinion, that the adoption of such a feature in the design would considerably improve the general effect and importance of the intended building.

I have, &c.,

The Viscount Duncannon. Charles Barry.

Whitehall Treasury Chambers, Sept. 14, 1841. T. F. Freemantle.

PROFESSIONAL CHARGES.

VIGNOLLES *v.* LEFROY.

At the last Summer Assizes held at Liverpool, August 30, the following important action was tried against the Hon. Thomas Lefroy, M.P., as one of the directors of the Central Irish Railway Company, to recover compensation for work and labour performed by the plaintiff as an engineer.

Mr. Dundas, Mr. Martin, and Mr. Watson were for the plaintiff; Mr. Cresswell, Mr. Wortley, and Mr. Cleersby for the defendant.

The details of the case were long and tedious, but the following were the principal facts:—

It appeared in the case for the plaintiff, that, in the year 1836 a number of gentlemen, connected with Ireland, were of opinion that a railway from Dublin to Sligo, running through the centre of the island, would be a desirable undertaking. Of these, the defendant was one of the most active. Preliminary meetings were held, prospectuses issued, the usual staff appointed, and other measures taken for carrying the project into execution. A provisional committee was formed, at whose meetings the defendant usually attended, and very frequently took the chair. The meetings took place, whether in London or Dublin, usually at the offices of Messrs. Young, Murdoch, and Leahy, solicitors to the company. The services of an engineer being required, some discussion took place on the appointment. A person of the name of Walker was mentioned, but it was afterwards decided, very much at the instance of the defendant, that the plaintiff, who had been the engineer of the North Union, the Midland Counties, and the Dublin and Kingstown Railways, should be requested to undertake the office. The solicitors for the company communicated with him, and he accepted the situation on the 4th of June. Immediate steps were taken for completing a survey, and a number of Mr. Vignolles's pupils and assistants were set to work upon the line. He himself paid frequent visits to Ireland in superintendence of the work up to the 21st of September, during which time frequent meetings of the committee had taken place in London and Dublin, at which the defendant presided, and on which occasions resolutions were come to as to the course which should be adopted, and the measures which should be taken in advancement of the project. One subject of discussion was, the site for the Dublin terminus, and on this point some correspondence took place between the plaintiff and the defendant with reference to a meeting to discuss the matter in Dublin, and the course which should be adopted respecting it. In one of these letters the defendant says, that the terminus at Kilmainham would not go down with the Dublin people, and that he must rely upon the skill and industry of Mr. Vignolles to select a better one. On the 21st of September a meeting of the committee took place, at which the possible appointment of Mr. Vignolles to the office of engineer to the Irish Railway Commission was brought under their notice, and it was agreed that his name should cease to appear as the engineer to the company, being replaced by a Mr. Nimmo, one of his assistants, who had previously been carrying on the survey under his superintendence. It was, however, for the plaintiff, alleged that he continued really to superintend the work as before, and that Mr. Nimmo was acting under him, and not as an independent engineer. The plaintiff went to Ireland repeatedly, and carried on a correspondence with Mr. Nimmo when in England. The work was then completed, the surveys made, and the necessary maps and books of reference deposited in the Parliamentary offices. Mr. Nimmo died in 1839. The present action was brought by Mr. Vignolles for the balance due to him for these engineering services. He had received 500*l.* His charge was 40*l.* per mile on a line of 126 miles. Much more, it was said, had been surveyed, including the lines which had been abandoned as not eligible.

For the defendant it was contended that there was no contract between him and the plaintiff, and that though, as a public man and a member of Parliament, he had encouraged a project which it was supposed would be of public benefit, he was not himself one of those embarked in the speculation, had never taken or been allotted any shares, and had merely given the provisional committee his assistance and advice. It was alleged that at all events the plaintiff had resigned his office of engineer in September, when appointed to the Royal commission; and that, even supposing he had executed all the work, the charge of 40*l.* per mile was excessive. Considerable payments had been made to Mr. Nimmo.

The case occupied the whole day, and at nearly 8 o'clock the Court adjourned, postponing his Lordship's summing up until the following day, when his Lordship having gone through the facts of the case,

The Jury retired for a considerable time, and brought in a verdict for the plaintiff—Damages 1,980*l.*, being the balance due up to September 21, when they were of opinion he ceased to be engineer to the company.

Exportation of Machinery.—The select committee of the House of Commons, lately appointed to inquire into the operation of the existing laws affecting the exportation of machinery, have just published their second report to the House. This report is much too long to allow of any detailed reference to it, but we subjoin the final recommendation of the committee on the subject, which is to the following effect, viz.:—"That, considering that machinery is the only product of British industry upon the export of which restraints are placed, the committee recommend that the law prohibiting the export of machinery should be repealed, and the trade of machine making be placed upon the same footing as other departments of British industry."

STIRLING'S AIR ENGINE.

Messrs. Stirling have constructed an air-engine, now working at the Dundee Foundry, which fully realizes the expectations of the inventors: its superiority over the steam engine consists in an immense saving of fuel, and in its capability of being contained in a very small space. For the purposes of navigation these properties are invaluable. We subjoin a description of the air-engine, furnished us by a friend well acquainted with mechanics.

The air-engine now working at the Dundee Foundry, for which a patent was lately taken out, is the joint invention of the Reverend Dr. Stirling, of Galston, and of his brother, Mr. Stirling, engineer, Dundee.

The principle of the invention consists in alternately heating and cooling two bodies of air confined in two separate vessels, which are arranged so, that, by the stroke of two plungers worked by the engine, while the whole of the air contained in one of the vessels is at the lower end immediately over the furnace, and is consequently quite hot; the whole of the air contained in the other vessel is at that time disposed at the upper end, which is cut off from any communication with the furnace, and is therefore comparatively cold.

The expansion caused by the heat renders the air in the one vessel much more elastic than that in the other; and the two ends of the working cylinder, which is fitted with a piston similar to that of a steam-engine, being respectively connected with the two air-vessels; a preponderating pressure is produced on one side of the piston, and it is thereby pushed to the opposite end of the cylinder. By the alternate action of the plungers in the two air-vessels, this end of the cylinder then comes in its turn to be subjected to the pressure, and the piston is thereby pushed back again to its former position, and so it continues a reciprocating motion, and is applied to turn a crank in the same way that a steam engine does.

It has been satisfactorily shown that this engine may be worked with very great economy of fuel as compared with a steam engine; and the principal means of producing the saving is this; that, of the heat which is communicated to the air from the furnaces, only a very small portion is entirely thrown away when the air comes again to be cooled; for, by making the air, in its way from the hot to the cold end of the air-vessel, to pass through a chamber divided into a number of small apertures or passages, the great extent of surface with which it is thereby brought in contact, extracts in the first place, but only temporarily, the greater part of the heat from the air; and afterwards restores it to the air on its passage back again from the cold to the hot end of the vessel. The process of cooling is finally completed by making the air to pass through between a number of tubes in which there is a current of cold water, and thus far the heat cannot be made available again, but the portion which is abstracted in this way is very small.

As a sufficient expansive power could not be attained from using air of the common density of the atmosphere; without either making the diameter of the cylinder, and all the other parts of the engine inordinately large, or subjecting the air to greater alternations of heat and cold than would be convenient; the air is used pretty highly compressed, and a much greater power is thereby obtained upon a given area of the piston.

It is necessary therefore to employ a small air-pump to keep up the air to the requisite density: but very little power is expended on this; for, as the same body of air is used over and over again, all that is required of the air-pump, after the engine has been once charged, is to supply any loss that may arise from leakage; and this is found to be very trifling.

The machine has been working occasionally for about six months, and it has been proved, to the satisfaction of the inventors, to be capable of performing advantageously the amount of work which they had reckoned on, from their calculations, and from former experiments made on a working model of about two horses' power. It has now, for upwards of a month, been doing work in driving all the machinery employed at the extensive engineering works of the Dundee Foundry, which a steam engine of approved construction had hitherto been employed to do; and it has been ascertained that the expenditure of fuel is, *ceteris paribus*, only about one-fifth part of what was required for the steam engine; but, as considerable improvements are contemplated in some of the details, it is confidently expected that a much greater saving of fuel eventually will be effected.

The whole machine, including its furnaces and heating apparatus, stands in about the same space that a steam engine of equal power would occupy without its furnaces and boiler; and, taking into account this saving of space, along with the vast saving of fuel, the invention must necessarily be of immense importance for all ordinary purposes requiring motive power; and, as an instance, it would reduce the expense of the power employed in driving machinery in Dundee alone by at least 25,000*l.* or 30,000*l.* a year; but, viewed in reference to the purposes of navigation, the application of this invention must lead to results still more extraordinary, and will render a voyage to India round the Cape, by machinery, a matter of perfectly easy accomplishment.—*Dundee Advertiser.*

Herculaneum—It is stated that the Neapolitan government have resolved upon undertaking some new excavations at Herculaneum and its neighbourhood, and it is added that they will be on an extensive scale. Negotiations have commenced already with this view for the purchase of various estates on the spot: and so soon as these purchases have been completed the works will be commenced. A commission of antiquaries and architects is to be appointed by the Minister of the Interior and the Royal Academy of Sciences to preside over the operations of the workmen; and no doubt discoveries will be made to add largely to the present knowledge of this interesting ruined city, and the manners and customs of its former inhabitants.

THE ZINKING PROCESS.

We derive from the *Revue Generale de l'Architecture* the materials for the following notes on the process of zinking iron, as described by the Baron Menn de Mesnil, in the Report of the Committee of Inquiry to the Minister of Marine in France. On the importance of preserving iron from oxydation it is unnecessary to make any remark, we may just observe that the only effective modes hitherto used have been tinning and glazing. In 1742 M. Maloin presented to the Royal Academy of Sciences a memoir on the analogy which he had observed between iron and tin, and points out a mode of zinking iron similar to the modern one. Whether the price of zinc was then too high or other difficulties stood in the way, it was not until 1836, that the process of zinking was made effective by M. Sorel, who took out a patent for it under the name of Galvanization of Iron. On the 28th September 1838, a committee was named by the Minister of Marine to make experiments in the dockyard at Brest on zinking iron, by them a first report was made recommending experiments to be made on a larger scale, which latter commenced on the 14th of May 1840, and it was on the 30th April of the present year that they made their report.

The process consists simply in dipping an iron article, previously cleaned with acid, for 3 or 4 minutes into zinc infusion, then taking it out progressively, shaking it in the air to get rid of the excess of zinc, and at last plunging it suddenly in cold water; after which it only requires to be rubbed over with fine sand and dried. What is called Galvanization is therefore nothing more than a process similar to tinning: but while iron is rendered more oxydable by contact with tin, and oxidizes rapidly, if by any mistake in the preparation the iron is left uncovered in any point: in zinking, on the contrary, a true alloy of zinc is formed on the surface of the iron, and the parts accidentally left unzinked alone rust, and the evil is soon stopped. This latter fact is enough to prove that the iron is not protected by any Galvanic effect as is the opinion generally received. Thus in the operations preparatory to zinking, such as cleaning by acid, &c., great care is taken to free the surface of the iron by scraping from it all matters which would resist the action of the acid, and prevent zinc from attaching to the iron all over.

The cleaning with acid is an operation which requires much care, for while it is indispensable that the iron subjected to the acid should be wholly free from rust, care must also be had that the iron be not too strongly acted upon by the acid, but be taken out at the proper moment. Very weak acids only are used for the cleaning as a mixture of nine parts of sulphuric acid with 100 of water. In France the refuse acid used in purifying vegetable oils is also employed; after a certain time the acid can no longer be used, as it is almost wholly turned into sulphate of iron, a salt which may be readily extracted, and which would bring more than the worth of the acid used. The time during which the iron is kept in the acid varies according to the degree of rust from 12 to 24 hours.

The pieces after coming out of the acid bath are cleaned and passed rapidly into hydrochloric acid of 15°, and then put in a stove to be quite dried. It is in this state of absolute dryness that they may be plunged into the zinc infusion. At the time of immersion the object is powdered over with sal-ammoniac, a great part of which volatilizes, and then decomposes, and the remainder, the acting portion, cleanses the object a third time, and makes the zinking certain and perfect. The use of this salt, on account of its value and the large quantity used, forms a great part of the cost of zinking. The zinc bath soon becomes covered with a black fluid matter, without adherence to the surface of the bath, on which it forms a continuous layer. The workmen consider it as advantageous to the zinking, and therefore take it out of the bath after the day's work, and put it in again the next morning, when they go back to work. During the night the zinc it kept in fusion, and the surface exposed to the air, is tarnished and oxydized, and it may be therefore allowed that the black matter acts so as to dissolve the oxide formed, and thus to restore the surface of the zinc to the purity requisite for zincing properly. An analysis of this black matter, made at Brest by M. Langonné, First Class Naval Apothecary and Member of the Committee, shows it to be composed of a great quantity of chlorure of zinc, a small portion of chlorure of iron, and an insoluble compound of ammoniac and zinc. As we know therefore that chlorure of zinc and ammoniac are good detersives, it is not surprising that the black matter, having an analogous composition, should be equally efficacious. The time that objects remain in the zinc bath depends on the dimension, if they are thin, they must be only rapidly passed through, if massive they must be left some minutes. In general it is enough to take the objects out as soon as they leave off giving out smoke or rather steam.

The immersion of the zinked object, still quite hot, in cold water, is for the purpose of preventing the formation of oxide of zinc, which tarnishes the surface, but this operation gives the iron a kind of tempering, which added to the effect of a layer of alloy covering the surface, renders it more brittle. Sheet iron in particular, on account of its thinness, is subject to this inconvenience, and can no longer be bent with ease. An improvement has however been recently made, which avoids the dipping, the slight layer of oxide of zinc which is formed on the surface, and which does not stick, is easily got rid off by rubbing after the object has been cooled in sawdust and sand.

When objects have just been zinked, they have a metallic lustre, which they will keep for a long time, when free from damp, but when left in the air they by little and little tarnish, become covered with a whitish efflorescence, which increases, acquires consistency, sticks to the metal, and soon forms a continuous and solid layer, which preserves the surface from ulterior alteration. This transformation is slow in taking effect, and appears to be complete only after 15 or 18 months' exposure to the air. Even the weakest acids and the alkalis attack and dissolve the zinc with the greatest facility and bare the iron. Heated red for several minutes the layer of zinc in excess soon peels off, but the iron is not yet bared, as the alloy of zinc and iron, more adherent, harder, and less fusible, long repel the action of heat.

The thickness of the zinc layer is very small; on cannon balls it was only 16 hundredths of a millimeter, on sheet iron it was from 7 to 12 thousandths of a millimeter, 9 thousandths is the mean. The thickness has little effect on the windage of cannon balls, but the committee suggest that zinking might be employed to increase the diameter of deficient balls. The committee farther suggest that experiments should be made to zinc old iron objects in order to preserve them. The thickness of the layer of zinc, although so very small, is amply sufficient, when we consider that an alloy is formed with the iron, which extends its protective influence deeper into the metal.

The influence of the air or water is very little on the zinked iron, if entirely exposed, but if subjected to the action of water and air alternately, they are more affected. Zinked apparatus produces no injurious effect upon drinkable water.

As to the various articles on which they experimented the committee report that the zinking appears very effective for roofs and cisterns. Zinked nails and bolts are recommended for shipping, but the committee are not yet prepared to recommend them to supersede copper. These nails are recommended for the decks of ships, as the ordinary nails soon produce a black spot on the surface of the wood, which penetrates and affects the fibres, gallate of iron being produced. Zinked nails are strongly urged as substitutes for iron in securing slates on roofs, as the iron nails soon rust, particularly near the sea, and in high winds are the chief cause of the slates falling. The zinked gutters the Committee consider will supersede tin. For the flues of stoves the zinked iron is recommended, and zinked wire also meets with their approbation. They had not made sufficient experiments as to chains, but they reported that those which they had tried, when put to the hydraulic test, supported it well. For locks and bolts in lighthouses and sea buildings, zinking is exclusively advocated. An advantage which zinc possesses for ear-rings for sails is that it does not rust the sails, which is apt to rot them.

The Committee conclude by making several recommendations. They report that zinking of wrought and cast iron can easily be practised in all ordinary circumstances of the use of that metal, that zinking shows every symptom of durability, and that it is of the greatest advantage to the navy. They consequently recommend a contract to be made with the patentee for the use of zinc in the arsenals of France, being convinced of its efficacy.

S. L. AND CANDIDUS.

The question at issue between S. L. and myself seems as it were about to be protracted as interminably as a Chancery suit. However we now seem to understand each other somewhat more clearly than at first:—at least there is one point on which he expresses himself decidedly, and on which I can cordially agree with him; since so far from attempting to defend, he unscrupulously reprobates that sickly soidisant *Greekism*, and pseudo-classical style, which during the last thirty years have given us so many "insipid abortions," where opportunities—now, alas! not to be recovered—presented themselves for achieving noble and original works.

Most certainly S. L. is not mistaken, when he imagines I will admit that Grecian and Roman architecture affords resources not yet worked out, ideas so capable of being yet further extended, that they may be said to be as yet only very partially developed, whereas they have only been studied and cramped in the mechanical productions of the school. My chief surprise is that he should for a moment doubt or affect to doubt my sentiments on that head, when I have more than once plainly stated—though perhaps in the very same terms I now use—that I am not an admirer of any one style in particular, however excellent it may be, to the exclusion of all others. My architectural creed is of a more liberal and comprehensive kind: it is free from those narrow sectarian prejudices that blind some to all beauty—all merit that does not come under the standard of their favourite style. So very far am I from being one of those who can not only tolerate, but admire even inferior productions, provided they do but belong—if only nominally—to what they consider the only legitimate mode, that as far as æsthetic value is concerned, I hold the manner in which a style is treated to be even of more importance than the question of style itself. So long as the work itself manifests artistic spirit, feeling and power, the particular language of the art, it happens to be composed in, is comparatively of little or no moment, however important it may be from other considerations attending any given case;—so far at least adopting Pope's doctrine that

"Whate'er is best administered is best."

By no means, was it my intention in what I first said to uphold the Gothic in preference to all other styles, nor did I conceive that it would be so construed by any one. And having thus cleared up S. L.'s misconceptions—or at least his doubts, I may now leave him to call Welby Pugin to account, as being a far greater offender—not only a staunch advocate for Gothic, but so exceedingly intolerant withal, that he would, were it in his power, exclude and uproot every thing else. Yet, should he have read the Professor's "True Principles," S. L. will probably not care to measure his strength with so redoubtable a champion. In case they should ever so encounter each other in argument, they may probably be so well matched that each will make a convert,—as such things have happened before now, and that S. L. will be converted to Puginism, while Pugin goes over to "Paganism."

Candidus.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

April 6.—The President in the Chair.

Experiments on the strength of Iron Girders. By Thomas Cubitt, Assoc. Inst. C. E.

This communication gives in a tabular form the results of experiments upon upwards of 60 pairs of cast iron girders, varying in length between 7 ft. 6 in. and 27 feet, with corresponding depths, and of all the forms usually adopted for beams for buildings. They were proved in pairs by a hydraulic press placed between them, the ends being retained by wrought iron ties. The deflexion was noted at each increase of pressure, and in many instances the beams were fractured.

Sketches of the girders, and of the apparatus used for proving them, accompanied the paper; from them five drawings have been made at the Institution to facilitate a reference to the information contained in the communication.

Description of an improved Level and Stand. By G. Townsend.

This improvement being intended to procure a firmer basis and greater facility of adjustment than by the ordinary level, the author has adopted the principle of the triangular plate, with three levelling screws. In the ordinary instrument, with two pairs of screws, it has been found that the antagonist screws, besides being apt to wear unequally, and to indent the lower plate, are sometimes bent, and thus cause an unequal action upon the upper plate. To obviate these defects, the screws in the tripod level are made to work into inverted cones, which are fixed in the three grooved arms of the stand head; the weight is more equally distributed, and the telescope more speedily brought to a level.

The telescope is fixed to the levelling plate by an upright limb, and to this is added a small longitudinal cross level, as in Gravatt's instrument. In the improved stand, each of the legs is attached to two arms of the lower tripod plate, by which means a firmer basis is obtained. The usual locking plate, to secure the levelling screws, is also attached to this instrument, and kept in place by a spring catch; there is also a metal ring fixed on the upright limb, above the arms, and which falls into three spring catches in the table plate, by which any derangement from accidental violence, or in removal from one station to another, is effectually prevented.

A small circular spirit level is fixed in the stand in order to adjust it before the instrument be placed on it, by which means the labour of adjustment is considerably abridged.

April 20.—The President in the Chair.

Experiments for determining the position of the Neutral Axis of rectangular beams of Cast and Wrought Iron and Wood, and also for ascertaining the relative amount of compression and extension at their upper and under surfaces, when subjected to transverse strain. By Joseph Colthurst.

These experiments were undertaken in consequence of the difference of opinion which has long existed respecting the position of the neutral axis of extension and compression of iron and wood.

First experiment.—Two series of experiments were made to determine this point by cutting through the centre of each of a set of eight girders, each 6 ft. 6 in. long, 5 in. deep, and half inch thick, the first to the depth of half an inch, the second to the depth of 1 inch, and so on, to the eighth girder, in which only 1 inch of metal remained unsevered. The spaces cut out were then filled with carefully fitted wrought iron keys, and the girders were broken by the application of weights, in the expectation that these weights would be some indication of the neutral point of each girder. The results were, however, so irregular, that no satisfactory deductions could be drawn from them.

Second experiment.—The next attempt was made in the manner suggested by the late Mr. Tredgold, by drawing two fine lines, $2\frac{3}{4}$ inches apart, on a polished surface at right angles to a girder, in the middle of its length; it was then subjected to strain, and dimensions were sought to be taken to determine where their divergence and convergence commenced, but the differences were too small to be susceptible of accurate determination, otherwise than by a fine micrometrical operation, which at the time the author had not an opportunity of applying. The following plan was therefore adopted.

Third experiment.—In the side of a cast-iron girder, 6 ft. 6 in. long, 7 in. deep, and 1 inch thick, a recess was planed at the centre, 3 in. wide by $\frac{1}{4}$ in. deep. This was filed up very true, and fourteen small bars of wrought iron, with conical ends, were placed in it at regular distances of $\frac{1}{2}$ an inch apart. These bars were of such lengths as to hold sufficiently tight to carry their own weight, and yet that the slightest touch should detach them. The girder was then subjected to strain. The supports were 6 feet apart; with a strain equal to 100 lb. the lower bar fell out; as it was increased, they continued to drop, and with 1500 lb. all those below the centre had fallen. The strain was then increased to 7000 lb., but no more bars fell. The centre bar remained exactly as when put in; all those above the centre became firmly fixed, and were evidently under considerable compressive force. The strain was then gradually taken off, and all the bars above the centre fell out, their ends having become compressed by the sides of the recess pressing on them; they were of course too short when the girder resumed its former condition, and the recess its previous width. These experiments were repeated several times, with pieces of fine wire and dry lance-wood charred at the ends.

The result in every case showed that the *neutral axis* of extension and compression was certainly situated within $\frac{2}{10}$ of an inch of the centre.

Another experiment was still more decisive. A girder 9 ft. 6 in. long, 8 in. deep, 1 in. thick, was cast with two brackets or projections on the side, each 9 in. on either side of the centre. A brass tube bar, with circular ends and a sliding adjustment, was fixed between the brackets, which had been filed true. The clear bearing was 7 ft. 6 in.; a strain of 50 lb. was sufficient to cause this bar to drop out; and with 250 lb. the whole effect of the previous experiment was produced. The tube, when placed loosely, 1 inch above the centre, was held fast by a strain of 1000 lb.

Wrought Iron.—Similar experiments were then made on wrought iron, with precisely the same results, showing that the neutral axis, if not actually situated at the centre, was nearly identical with it.

Wood.—A similar series of experiments, made upon wood beams, gave exactly the same results as regarded the position of the neutral axis.

From all the foregoing experiments, the author concludes that the neutral axis of extension and compression in rectangular beams of cast and wrought iron and wood, is situated at the centre of their depth, when those beams are subjected to transverse strains.

Extension and compression. Cast Iron.—Experiments were also instituted to ascertain the amount of extension and compression of cast and wrought iron and wood.

Upon a bar of cast iron, 3 inches square, and 9 feet long, two strips of thin hoop iron were attached, the one on the upper, and the other on the lower side, each strip being fastened to the bar at one end only, while the other end was left free; any change which occurred in the length of the surface to which it was applied was clearly indicated. The differences were recorded by very fine lines on a polished surface. The strips were 7 ft. 6 in. long, and were bound to the whole length of the beam by bands of fine wire, wound round and enclosing them at every 9 inches; the beam was then subjected to strain, and the following results were obtained:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
1000	0·22	..	..
2000	0·45	$0·04\frac{1}{2}$	$·04\frac{1}{2}$
3000	0·65	0·06	0·06
4000	0·87	0·08	0·08
5000	1·20	0·11	0·12
6000	1·50	0·13	0·14

6240 the beam broke; good iron, showing a good clear fracture.

It will be perceived, that until rather more than two-thirds of the breaking weight was put on, the amounts of extension and compression did not sensibly differ, but between that point and the breaking weight, extension yielded in a higher ratio than compression.

Wrought Iron.—Similar experiments were next made on bars of wrought iron, 2½ in. square; the supports were 13 ft. 6 in. apart, and the strips of oop iron were 12 feet long.

Weight. lbs.	Deflection. inches.	Compression. inches.	Extension. inches.	Elasticity. impaired.
500	0·55	0·03	0·03	..
1000	1·55	0·06	0·06	..
1280	1·45	0·07	0·07	0·15
1560	1·85	0·08	0·08	..
1800	2·20	0·09	0·09	..
2000	2·70	0·11	0·11	0·65
2280	4·15	0·18	0·19	2·05

With this weight the beam was permanently bent, and its elasticity nearly estroyed.

These experiments showed that, differing from cast iron, the amounts of extension nd compression in wrought iron continue to be equal up to the complete destruction of the elasticity of the beam.

Fir battens.—The amounts of extension and compression in rectangular beams of fir tiober, when subjected to transverse strain, were next determined; the manner of proceeding was precisely the same as in the preceding experiments.

A batten, 4 in. by 3 in., with the supports 8 ft. 2 in. apart, and with strips 7 ft. 6 in. long, when subjected to transverse strain, gave these results:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
500	1·10	0·12	0·12
1000	2·30	0·24	0·24

Results.—From these experiments on the amount of extension and compression of cast iron, measured at the under and upper surfaces of rectangular beams, subjected to transverse strain, the author assumes, that within limits which considerably exceed those of elasticity, and equal to at least two-thirds of the breaking weight, there is no sensible difference between the amounts of compression and extension, and that as the breaking point is approached, extension yields in a higher ratio than compression, and gives way first.

It would appear certain that up to the point when the elasticity of wrought iron is completely destroyed, and the beam is bent, the amounts of compression and extension continue exactly equal, and it is therefore probable that this equality would continue to the last.

It is clear that the amounts of extension and compression up to three-fourths af the breaking weight do not sensibly differ in fir battens, but that as the ultimate strength of the beam is approached, compression yields in a much higher ratio than extension, and may be actually seen to give way first.

He states also, that the amounts of extension and compression are in direct proportion to the strain, within the limits of elasticity, and that even after those limits are greatly exceeded, and up to three-fourths of the strength of a beam, they do not sensibly differ.

The apparatus with which these experiments were made was exhibited, and presented by the author to the Institution.

Mr. Donkin eulogised the novel and ingenious manner in which Mr. Colthurst had conducted the experiments, which he considered to be highly satisfactory. They not only determined the position of the neutral axis of the beams experimented upon, but showed also the relative amounts of compression and extension, so as to demonstrate that the elasticity of a body was the same in compression as in extension. These experiments also confirmed the correctness of Tredgold's opinion as to the pernicious effects of attempting to produce peculiar forms in beams by cambering and inserting wedges into their upper sides.

Mr. Vignoles reminded the meeting of the discussions which had taken place relative to the position of the neutral axis in the railway bars, which had the upper and under tables similar; it was contended that the neutral axis was situated close beneath the upper lip, or table of the rail, whereas, if Mr. Colthurst's mode of experimenting had been adopted, a different and more correct result would have been arrived at.

Mr. Cubitt accorded great merit to Mr. Colthurst for the experiments, which had determined the question as regarded rectangular beams. It appeared that no attempt had been made to use the same mode of proceeding with beams of irregular figures; in them, therefore, it might be concluded, that the neutral axis would be found in the centre of gravity of the section of the beam.

Mr. J. Horne remarked, that these experiments perfectly accorded with those which he laid before the Institution in 1837. His object had been to show that the neutral axis was always in the centre of gravity of the section, as well as to determine the figure which should resist the greatest amount of pressure with a given quantity of materials; the strongest form was shown to be a prism, placed with the base upwards, and the same figure reversed was the weakest; the strength of the former figure exceeded that of the latter by at least oue-third.

April 27.—The President in the Chair.

Memoir of the Montrose Suspension Bridge. By J. M. Rendel, M. Inst. C. E.

Previous to the year 1792, the passage of the River Esk at Montrose was effected by common ferry boats; at that period an act of parliament was obtained for the construction of a wooden bridge, with numerous arches, or rather openings formed by beams, supported upon piles, with stone abutments at either end; the action of the tide undermining the piles, and the usual progress of decay causing great expense for repairs, it was decided in the year 1825, to erect a suspension bridge, the iron work of which was contracted for by Captain Samuel Brown, R.N., for the sum of £9,430, and the masonry of the towers for £9,080. The total cost being £18,510, exclusive of the land arches and approaches; those of the old bridge being preserved for the new one.

The dimensions of the new bridge were—

	Feet.
Distance from centre to centre of the towers	432
Deflection of the chain or versed sine of the catenary	42
Length of the suspended roadway	412
Width of ditto	26
Height of ditto above low water	21
Ditto of the towers above ditto	68
Base of the towers at the level of the roadway	40 by 20
Archways through the towers	16 wide, 24 high

The towers were built of red sandstone ashlar, raised on a base of the same material, carried upon piles.

Construction.—There were two main chains on each side, arranged above each other in parallel curves, 12 inches apart. Each chain was composed of four bars of iron, 5 inches wide by 1 inch thick, and 10 feet long, united by short plates, and strong wrought iron pins. The roadway was suspended to these chains by perpendicular rods. 1¼ inch in diameter, attached at intervals of 5 feet, alternately to the upper and lower lines of main chains, at the joints, which were arranged so that those of the upper chain should be over the long bars of the lower one; at the lower end of each suspending rod was a stirrup, which received and carried the cast-iron bearers for supporting the roadway.

Upon these bearers was laid and rivetted longitudinally a flooring of fir planks, 3 inches thick, and well caulked; upon this a sheathing of fir, 1½ in. thick, was placed transversely, and spiked to the lower planks; over all was spread a coating of about 1 inch thick of fine gravel and sand, cemented with coal tar.

The suspending rods were without joints. The main chains rested upon detached cast iron saddles, built into the masonry of the towers, and passing down at either extremity, were secured behind cast iron plates in masses of masonry, 10 feet under ground.

The construction was commenced in September, 1828, and was finished in December, 1829, a period of only sixteen months.

Accident to the Bridge.—On the 19th of March, 1830, about 700 persons assembled on the bridge to witness a boat race, when one of the main chains gave way, and caused considerable loss of life. The injury was speedily repaired, but a careful survey of the structure was ordered, and it was discovered that the intermediate or long links of the chains bore so unequally upon the saddles as to be bent and partially fractured. Mr. Telford, who was consulted on the subject, proposed the addition of two other main chains placed above the original ones, and having the same curve, so as to increase the sectional area 40 inches—thus giving six chains of 20 inches area each, instead of four chains, as originally constructed.

Mr. Telford's decease occurring at that period, the author was instructed to report upon the state of the bridge, and advise such alterations as he judged to be necessary.

After a minute personal inspection he concurred in Mr. Telford's idea of the necessity of increasing the strength of the bridge, but instead of augmenting the number of the chains, he advised the addition of two bars in width to each of those existing, by which means the required strength might be gained. He was led to this by an opinion that, in all cases, it is desirable to have as few chains as possible.

It appeared that there had been but little precision in the workmanship of the chains; for on releasing them they immediately became twisted; thus showing that all the links had not a true bearing. On taking them apart, many of the traversing pins were found to be bent, and some of them were cut into, evidently by the friction of the links. This was to be rectified, and new saddles of a different principle and stronger form were recommended: also, that those parts of the chains which rested in the saddles should be entirely composed of short plates. Additions to the masses of masonry holding the chains were likewise deemed advisable.

Between the years 1835 and 1838, all the principal works, with many minor improvements, were executed.

In the author's report on the state of the bridge, he noticed what he deemed defects in the construction of the roadway, but as there was no positive symptom of failure, it was allowed to remain. He conceived, that in the anxiety to obtain a light roadway, mathematicians and even practical engineers had overlooked the fact, that when lightness induced flexibility, and consequently motion, the force of momentum was brought into action, and its amount defied calculation.

On the 11th of October, 1838, the roadway of the bridge was destroyed by a hurricane, the effect of which upon this structure is the subject of a paper by Colonel Pasley, published in part 3, vol. 3, of the Transactions of the Institution C. E. To that account the author refers for the principal details, only adding, that on inspecting the bridge, he found the chains, the saddles, and the fastenings or moorings, quite sound; the principal portion of the roadway had been completely carried away, and the remainder much injured. He then gives some account of the undulatory motion observed during the storm. This motion was greatest at about midway between the towers and the centre of the roadway; but the waves of the platform did not coincide with those of the chains, either in magnitude or in order; no oscillatory motion was perceived either in the roadway or in the chains, although particular attention was directed to them.

It appears that the centre of the platform fell in a mass. This the author attributes t the failure of the suspension rods, which having no joints, were twisted off close to the floor by the undulatory motion. A similar occurrence at the Menai Bridge* induced Mr. Provis to adopt the joints in the suspension rods, which the author had previously introduced at the Montrose Bridge.

The author had long been convinced of the importance of giving to the roadways of suspension bridges the greatest possible amount of stiffness, in such a manner as to distribute the load or the effect of any violent action over a considerable extent.

The platforms of large bridges, in exposed situations, are acted upon in so many different ways by the wind, that he had an objection to the use of stays or braces to counteract movements which ought rather to be resisted by the form of the structure.

Holding such opinions, he determined to adopt a framing which, although connectedly rigid in every direction, should nevertheless be simple, composed of few parts, capable of being easily renewed; should distribute its weight uniformly over the chains, not be subject to change from variation of temperature, and not augment the usual weight of suspended platforms.

The details of the alterations, and general repair of the bridge, are then given; a few may be mentioned.

An entirely new set of stronger suspending rods was introduced; they were $1\frac{1}{4}$ of an inch in diameter down to the flexible joint at the level of the platform; below that point the diameter was increased to $1\frac{3}{4}$ of an inch, and a strong thread was cut on to the lower end, so as to adjust them to the requisite lengths.

In the place of the cast iron bearers cross beams were substituted, composed of two Memel planks, 13 inches deep, $3\frac{1}{2}$ inches thick, bolted together, and trussed with a round bar $1\frac{1}{4}$ inch diameter; every sixth beam had a deep trussed frame on the under side, so as to give great stiffness. Above and beneath the cross beams, on each side of the carriage way, were bolted two sets of longitudinal timbers, four in each set; they were further united by cast iron boxes, at intervals of 10 feet; and the ends were secured to beams of English oak, built into the masonry of the towers. A curb of Memel timber, 11 inches by 6 inches, was attached to the ends of the cross bearers, and extended the whole length of the platform.

The planking of the footways was composed of narrow battens, 2 inches thick, laid transversely from the inner longitudinal beam to the outer curb piece, with an inclination or drip of $1\frac{1}{2}$ inch in 5 feet.

The carriage way was formed of four thicknesses of Memel plank; the two lower layers, each 2 inches thick, were placed diagonally with the transverse beams, crossing each other so as to form a reticulated floor, abutted against the longitudinal beams; they were firmly spiked to the beams, and to each other, at all the intersections, and upon them was laid and spiked a longitudinal layer of Memel planking, 2 inches thick. Over the whole was fixed, transversely, a layer of slit battens, $1\frac{1}{4}$ inch thick. Each layer was close jointed and caulked, and the upper one was laid in a mixture of pitch and tar. A composition of fine gravel and sand, cemented with boiled gas tar, was laid over the whole, to the thickness of 1 inch, forming the road track.

To add to the stiffness afforded by this construction, the author caused to be passed through the spaces between the pairs of longitudinal beams, a series of diagonal truss pieces of Memel timber, 6 inches square, with their ends stepped into the cast-iron boxes, which, at every 10 feet, grasp the beams. On the other ends of these diagonal truss pieces, cast iron boxes were fixed, which received the straining pieces, placed 3 ft. 6 in. above, and the same depth below, the roadway: an iron screw bolt, $1\frac{1}{4}$ inch diameter, at every 10 feet, and a contrivance of wedges in the cast iron boxes, enabled any degree of tension to be given to the framing.

The roadway was thus stiffened by two of the strongest kinds of framing, in parallel lines, dividing the carriage way from the foot-paths; it was deemed preferable to disconnect them from the suspending rods, and, by bringing them nearer together, to avoid a twisting or unequal strain. The whole formed a compact mass of braced wood work, the diagonal planking giving the horizontal stiffness, and the two trussed frames insuring the vertical rigidity.

The weight of the new roadway was—	Tons.	Cwt.
Wood work	130	19
Cast and wrought iron about ditto	36	6
Wrought iron in the suspending rods	20	14
Ditto in the fencing	8	18
Gravel concrete	30	0
Total	226	17

Or 47.5 lb. per square foot, superficial, for the entire roadway.

* Minutes of proceedings, pages 167, and 204.

The weight of the original roadway was—	Tons.	Cwt.
Wood work	69	0
Cast iron about ditto	92	0
Wrought iron in the suspending rod	12	9
Gravel concrete	30	0
Total	203	9

Or 23 tons less than the new roadway.

Cost.—The platform described is 412 feet long, and 27 feet wide; it cost £4026 or about 7*s*. 3*d*. per superficial foot.

The works were completed in the summer of 1840; the bridge has borne without injury the gales of the last winter; and the stiffness of the platform has given confidence in its strength to all who have examined it.

Five elaborate drawings of the bridge, giving all the details of its construction on a large scale, accompanied this communication; they were presented by Mr. Page on his election as an Associate of the Institution.

Mr. Seaward agreed with Mr. Rendel in the advantage of reducing the number of suspension chains, and thus rendering the whole construction as simple as possible. The trussed framing, which appeared to be the main feature of this bridge, was particularly deserving of commendation, as it imparted a degree of stiffness to the platform which had not hitherto been attained in other cases, although it was demonstrated to be the best method of preventing the undulation which was so prejudicial to the suspension bridges.

Mr. Rendel had, on a previous occasion,* explained his view of the action of wind upon the platforms of suspension bridges, and of the necessity of a certain degree of stiffness in the construction; this he conceived would always be better attained by having a simple well-trussed framing to prevent undulation, than by the application of braces or stays to check either undulation or oscillation—the latter being in his opinion only the result of the former.

He would now only insist more forcibly upon those points. The roadway should be so stiff as to prevent as much as possible all tendency to motion, because it added to the natural decay of every part of the structures; for instance, he found on taking down the chain of the Montrose Bridge, after seven or eight years' wear, that the pins of the links were cut some depth into; demonstrating how great had been the amount of motion among the links. In constructing suspension chains, after this experience, he should be inclined to abandon the circular form for the pins, and forge them of a long oval shape in their transverse section; making the apertures in the links by drilling two holes, and cutting out the metal between them with a machine; this form of pin would allow sufficient play for the necessary curve of the chain, while the pin itself would be stronger, would weaken the link less than the large circular hole, and would be less expensive to manufacture. He disapproved of all the complicated contrivances for allowing expansion of the main chains; he had found that plain saddles of proper form were quite sufficient to permit the expansion of the back chains, which was all that required attention.

Mr. Palmer mentioned, on the authority of Mr. Chapman, the destruction of a suspension bridge in America, caused by the sudden passing of a drove of cattle when frightened. This was peculiar, as it always had been considered that an irregular motion was innocuous, but that when any regular impulses were communicated, there was danger of fracture of the bars.

Mr. Vignoles eulogized this excellent communication for the practical conclusions which it contained. Mr. Rendel had materially assisted in affording facility of communication by the introduction of the floating bridges, in communication with railways, and it was not difficult to foresee that, by carrying out the system of adapting well-trussed framings to the platforms of suspension bridges, sufficient rigidity would be attained for locomotive engines and carriages on railways, to traverse rivers or ravines by means of these bridges, instead of by costly viaducts or heavy embankments.

Mr. Rendel saw no difficulty in giving any required amount of rigidity to the platforms; it was only necessary to increase the strength of the framing, to enable the roadway to bear with perfect safety the passage of an engine and a train of carriages.

The President directed the attention of the members to what he considered the most valuable part of this interesting communication—the detection of the errors in the original construction of the bridge. This was the most useful class of papers which members could present to the Institution, and they were particularly valuable when they were illustrated by such complete drawings as those now communicated by Mr. Page on his election. He hoped this example would be extensively followed. He mentioned that an attempt had been made to carry a railway across the Tees by a suspension bridge, but it had been abandoned.

Mr. Rendel understood that the weight of the trains had so stretched the chains, or rather forced the moorings of the back chains of the bridge over the Tees, that the platform sunk in the centre so as to prevent the passage of the carriages; piles had therefore been driven beneath each bearer of the roadway, and the chains now remained merely to show that it had formerly been a suspension bridge.

May 4.—The PRESIDENT in the Chair.

"*Supplementary Account of the Use of auxiliary Steam Power, on board the 'Earl of Hardwicke' and the 'Vernon' Indiamen.*" By Samuel Seaward, M. Inst. C.E.

* Minutes of Proceedings, page 205

The advantage of the employment of auxiliary steam power, on board large sailing ships, had been shown by the author in a former paper (p. 63); it was now further exemplified by the result of the recent voyages of the "Earl of Hardwicke" and the "Vernon."

Earl of Hardwicke.—This vessel, of 1000 tons burthen, with one engine of 30-horse power, effected the voyage from Portsmouth to Calcutta in 110 days, a much longer time than usual; but still with an advantage of 29 days over the "Scotia," a fine vessel of 800 tons, which sailed one week before the "Hardwicke," and arrived 22 days after her. During the voyage, the "Hardwicke" used her engine 364 hours, and was propelled by it 946 knots; an average of nearly three knots per hour: while in a calm, with the ship steady, she made five knots per hour. The total consumption of fuel was 90 tons.

The "Vernon," which sailed one month after the "Hardwicke," made her passage to Calcutta in 97 days; passed the "Scotia," and arrived seven days before her, gaining 42 days upon her during the voyage. The "Vernon's" consumption of fuel was also 90 tons, but the copy of her log not being arrived, the number of hours during which steam was used, could not be ascertained.

The "India" steam ship, of 800 tons burthen, with engines of 300 horse power, had not arrived at Calcutta, although she had been out 109 days, so that the "Vernon," with only auxiliary steam power, had already gained 12 days upon her.

The comparison between the advantages of these two vessels, in point of expense, is then fully entered into, and shows a saving of £3733 in favour of the "Vernon," on a single voyage, while she gained at least 12 days upon the "India," in point of time.

This communication is accompanied by a copy of the log of the "Earl of Hardwicke," and by letters from the captains of that ship and the "Vernon," speaking in the highest terms of the assistance of the steam power in certain parts of the voyage."

"Description of an improved Levelling Staff, and a modification of the common Level." By Thomas Stevenson.

In enumerating the advantages of this improvement, the author passes in review the different levelling instruments in general use. He describes the self-reading staff as very useful, but ill adapted to the extreme accuracy generally necessary in the operation of levelling.—He considers the running level to be equally inadequate, from the difficulty of attaining a precise coincidence in the cross wires and the vane line.

On the authority of Mr. Simms, in his Treatise on Mathematical Instruments, he states that these evils are in some measure remedied by Mr. Gravatts' rod, but he still considers that instrument to be imperfect. He therefore caused a rod to be constructed by Mr. Adie, of Edinburgh, the vane of which is adjusted by tangent screws. The range of this staff is 12·7 feet, and the graduation so perfect as to be read by verniers to the $\frac{1}{1000}$th of a foot. On the right of the lower portion of the rod there is a screw, which, on being tightened, clamps the vane, and on the opposite side is the tangent screw for adjusting it. Supposing in practice that the level line strikes the lower half of the rod, the vane and screw are then easily moved by the hand to within ¼ inch of the point, and then, by means of the tangent screw, perfect correctness can be attained.

After having sent his communication to the Institution, the author learnt from the Secretary that adjusting screws had already been used in two other levelling staves by Captain Lloyd and by Mr. Bunt. He was not, however, aware of this circumstance, and he considers that these instruments being adapted only for scientific purposes, are hardly suitable for the ordinary use of the engineer.

Improved Level.—The author also introduced a ball and socket joint at the junction of the legs of the common level, retaining at the same time the parallel screw plates, and adding beneath a small sluggish spherical level. By these means the surveyor is enabled to station the instrument, regardless either of the inequalities of the ground, or of the inclination of the telescope to the horizon.

When in use the clamp of the ball and socket is released, and the head of the level moved until the bubble shall be in the middle of the circle; the socket screw is then clamped, and the telescope brought to the absolute level by means of the parallel screws. It becomes thus unnecessary to move the legs of the instrument when once fixed.

"An improved mode of Paving Streets." By Edward Lomax.

In this communication the author proposes to remedy the danger and difficulty of stopping or turning horses during wet or frosty weather on wood pavement. His plan is, that a breadth of 2 feet 6 inches, near each side of the street, should be paved with stone, for the horses to travel upon, the carriage wheels still running upon wood; by which means all the advantages of that kind of pavement would be preserved without risk to the horse. In very wide streets a centre track might also be paved with stone.

By this plan the labour of the horse would be greatly diminished, a consideration portion of his power being now lost, because the wood pavement is less favourable for the footing of the horse than for the motion of the wheels.

The author is therefore of opinion, that granite pavement for the horse to travel upon, and wood pavement for the wheel way, would form a road on which the horse would work with the least loss of power, and the greatest safety.

A model of the proposed improvement accompanied the paper.

"Specimens of Sea-weed used for sea defences."

Mr. Macneill presented three specimens of the Sea-weed with which the Sea Embankments are formed in some parts of Holland.—He described one of the specimens in its natural state as resembling the weed which is collected by the peasantry on the western and north-western shores of Ireland, and used by them for bedding.—The second specimen was taken from near the bottom of the embankment at Niewe Diep, the entrance of the grand canal near the Helder. It was much compressed, but elastic.—The third specimen was less compressed; it was taken from the same embankment, above the range of the ordinary neap tides.

This embankment is of considerable width, and has very little slope towards the sea: the work appeared extremely compact and solid; he saw it when a heavy sea was running in, and each action of the waves against it caused a vibration throughout the whole mass—thus proving the elasticity of the material when consolidated, and corroborating the Hon. Mr. Stewart's description of the same effect upon the peat sod embankments, in a paper shortly to be laid before the Institution. Mr. Macneill spoke with confidence of the efficiency of the peat sod for sea defenees, as he had used it with good effect, although at present only to a limited extent.

The attention of the Members of the Institution was especially directed to the sea embankments of Holland, as affording excellent study and ample materials for communications for the meetings.

On Lead Sheathing for Ships. By J. J. Wilkinson.

The commencement of this communication, which is the continuation of the paper on the "Wood sheathing of Ships," which was read March 23rd (page 318), examines in great detail the various uses to which metals were put in the earliest period of which any record exists, and then it traces the first application of lead to the protection of shipping.

There are very early instances of ships and vessels being covered with lead. In the 15th century, a boat, 30 feet in length, was found in the Mediterranean sunk in 12 fathoms water; it was built of cypress and larch. The deck was covered with paper and linen, and over all with plates of lead, fastened with gilt nails; this covering proved so impervious to moisture, that parts of the interior were perfectly dry. It is supposed to have lain there above 1400 years. A Roman ship was also found sunk in the Lake of Nemi. The hull was of larch; bitumen had been applied to the outside, over which was a coating of a reddish colour, and the whole covered with sheets of lead, fastened by gilt nails. The interior had a thick coating of cement made of iron and clay. The seams of the planks were caulked with tow and pitch.

Some of the ancient domes at Ephesus were sheathed with lead, and it appears that the column of Constantine at Constantinople was formerly covered with metal.

It is certain that lead mines were worked in Britain by the Romans; and long before the Conquest, plates of lead were used as coverings for ecclesiastical buildings. These coverings being designed to endure, were of very thick lead.

Water pipes.—In 1231, water was brought from Tyburn to London in pipes; but the material of the pipes has not been ascertained. In 1285, the great conduit in Cheapside was supplied with water conveyed through pipes from Paddington; these pipes are expressly stated to have been of lead. It has, however, been averred, that lead pipes for conveying water were first introduced by Robert Brook, in the reign of Henry the Eighth.

Sheet lead was used in Spain and Portugal for sheathing ships, and for covering the rudders, long before it was employed in England. It was used in Holland in 1666, and at Venice in 1710.—It is probable that we are indebted to Sebastian Cabot for its introduction into England; it is stated in his Memoirs that he first saw it used in 1514; he was then in the service of the king of Spain, which he entered in 1512, and was appointed pilot major; he afterwards returned to England, and in 1553 was named by Queen Mary, "Governor of the Mysterie and Company of Merchant Adventurers, for the discovery of Regions, Dominions, Islands, and Places, unknown."—Three vessels were fitted out for this purpose, under the command of Sir Hugh Willoughby, one of which was sheathed, or at least partly so, with thin plates of lead, then first mentioned as an "ingenious invention." This expedition was unfortunate—Sir Hugh Willoughby, with the crew of two of his ships, being frozen to death; one of the commanders, and his crew, alone escaped. This expedition was the origin of the trade to Russia, and of the Spitzbergen Whale Fishery.

In the reign of Elizabeth a patent was granted to one Humphrey, for melting lead, but was afterwards recalled, the plan not being new.

Milled lead.—It appears that, up to about 1670, cast sheet lead was used for sheathing; at that time milled lead was invented, and a patent for milling lead was granted to Sir Philip Howard and Francis Watson; by this process the inequalities, as well as the defects from air holes, in the former mode of manufacture, were remedied; the whole surface was rendered smooth and uniform, and the weight greatly reduced. This invention met with much opposition from the plumbers, who averred that it could not be durable; an offer was therefore made on the part of the Milled Lead Company, to keep in repair during 41 years all milled lead of the weight of 7 lb. per square foot, at the rate of five shillings annually per each hundred pounds worth in value.—One of the earliest vessels in the royal navy thus sheathed, was the Phœnix, a fourth rate. This was done at the express command of Charles II. This vessel made two voyages to the Straits, apparently for the express purpose of testing the new invention, and on her return in 1673, was careened at Deptford, and personally inspected by the King. An order was then issued that his Majesty's ships should in future be sheathed only with lead, excepting by especial order from the Navy Board. It appears that about 20 ships of the royal navy were consequently sheathed with milled lead, and fastened with copper nails.—Even the royal protection could not save this invention from cavillers, so that, in 1677 and 1678, complaints were made by Sir John Narborough and Sir John Kempthorne, that the rudder irons of the Plymouth and the Dreadnought were so much eaten, as to render it unsafe for those vessels to proceed to sea; these complaints were repeated in 1682.—The patentees maintained, on the contrary, that the damage to the rudder irons could not possibly arise from their being covered with lead, as it had been the invariable practice for a great many years, to secure the iron work of ships, generally, by lead covering, and especially by capping the heads of their bolts, under water, with lead, seized to and nailed over them. Reports too in favour of the invention were made by Sir Phineas Pett, and by Mr. Betts, master builder, at Portsmouth, in which the latter stated, that lead had effectually prevented the vessels becoming what is technically termed "iron-sick," meaning that the bolt-holes became so widened by corrosion, that the bolts were loosened; he recommended, however, that the lead sheathing should be stripped every seven years, on account of the decay of the oakum in the joints; declaring, too, that it became less foul on the voyage than wood sheathing, and was much more easily cleaned. These different opinions led to the issue of an Order in Council in 1682, for the appointment of commissioners to examine and report upon the alleged injury to the iron work by milled lead covering: it is probable their report was unfavourable, as it is said that the use of lead covering, fastened with copper nails, was abandoned on account of the rapid corrosion of the rudder irons. A controversy appears to have arisen on this subject, the merits of which it would be difficult to ascertain after such a lapse of years. Government, however, subsequently determined to make another trial of the value of lead covering; accordingly, the Marlborough was so sheathed, and laid up in ordinary, at Sheerness. A few years after, she was docked, at Chatham, in 1770, when it was found that the lead sheathing was covered with weeds, and the iron fastenings very much decayed: the lead was in consequence removed, and a wood sheathing substituted.

Mixture of metals.—Several patents were afterwards obtained for different mixtures of metal for this purpose, none of which seem to have succeeded, being all subject to the same inconveniences as the simple metal: among which was the influence of the sun in the torrid zone, which was said to reduce the lead, in the course of five or six years, to a calx.—Among these patents, for mixed metals for sheathing, is mentioned that of Mr. Bulteel, in 1693; it was found to have all the inconveniences of lead. Mr. Donithorne, in 1780, obtained a patent for sheathing, of a mixture of 112 parts of tin to 10 parts of zinc; this was also as objectionable as lead.—Slade's patent for sheathing with copper laid upon lead, and the patents of Wetterstedt, and of Muntz, for mixed metals, are examined; and the author promises a continuation of the subject, with the history of copper sheathing.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Eleventh Meeting, 1841.

(From the reports of the Athenæum.)

"*On Truscott's plan for Reefing Paddle Wheels.*"

Mr. Chatfield described, by reference to a model, an improved paddle-wheel, the principal feature of which was a new application of the principle of feathering and reefing. Each paddle or float is attached to an axis passing through its centre, with a crank at the extremity of the axis, and the feathering is effected by the motion of a roller attached to this crank, and moving in a groove eccentric to the wheels. The radii of the paddle wheel are connected at their extremities by a chain instead of a rigid rim, and the reefing is effected by drawing the radii together, like the folding of a fan, by means of a peculiar arrangement of the clutch box at the centre of the wheel.

"*On a Plan of Disengaging and Reconnecting the Paddle Wheels of Steam Engines.* By J. Grantham.

There are four cases in which it may be desirable to disconnect the paddle wheels from the steam engine in steam vessels, viz., when the vessel is on a long voyage, and the fuel must be economized as much as possible by using the sails on every favourable opportunity; when the engines are damaged, and, the vessel being close to a lee shore, it is necessary to disengage the engines quickly, to allow the vessel to make sail; when some derangement has taken place, and the engines are allowed to continue to work imperfectly to the end of the voyage, rather than detain the vessel by causing the paddles to drag through the water while the engines are stopped; when, the vessel being at anchor, the action of the swell and tide on the paddle floats, while stationary, causes a great additional strain on the cables, which would be obviated could the wheels play freely. The Admiralty had called attention to the subject, by inviting plans for effecting it. Several had been proposed for disconnecting the paddles, but Mr. Grantham is not aware of any plan having been proposed by which the wheels could be readily reconnected in a heavy sea. The crank pins are usually fixed in the cranks of the intermediate shaft, a little play being allowed in the eye of the crank of the paddle shaft, to prevent the crank pins from breaking when the centres of the three shafts vary from a straight line by the yielding of the vessel. For the purpose of disengaging and reconnecting, a brass box of a rectangular form is inserted in the eye of the crank of the paddle shaft, which can be moved several inches by means of a screw at the back of the crank. The eye of the crank is so made that two of its sides may be cut away, and through these openings the crank pin can pass when the box is drawn back, or the disengaging effected. The brass box has one of its sides, which restrain the crank pin when in gear, cut away one or two inches to assist in reconnecting the engine, which is effected by screwing the box out one or two inches, or just so far that the crank pin can pass the side which has been cut away, and come in contact with the higher side. This is the correct position for reconnecting, which is accomplished by a single turn of the screw.

Mr. Grantham, in reply to a question from Capt. Taylor, R.N., stated that he should consider it very dangerous to disconnect the paddle wheels without having first stopped the engine.

"*On the Propulsion of Vessels by the Trapezium Paddle-wheel and Screw.*"

Mr. G. Rennie gave an account of the various experiments to which he had been led, on the propulsion of vessels by various forms of paddle floats and by the screw. It was generally admitted that the paddle wheel was the best means of propulsion with which engineers were at present acquainted, and various attempts had been made for its improvement. There are several objections to the square or rectangular floats, particularly the shock on entering the water, and the drag against the motion of the wheel on the float quitting the water; both of which give rise to considerable vibrations. He had been led, in considering the improvement of the paddle wheel, to have recourse to nature: and the form of the foot of the duck had particularly attracted his attention. The web of the duck's foot is shaped so that each part has a relation to the space through which it has to move, that is, to the distance from the centre of motion of the animal's leg. Hence he was led to cut off the angles of the rectangular floats, and he found that the resistance to the wheel through the water was not diminished. Pursuing these observations and experiments, he was led to adopt a float of a trapezium or diamond shape, with its most pointed end downwards. These floats enter the water with their points downwards, and quit it with their points upwards, and then arrive gradually at their full horizontal action, without shocks or vibrations; and after their full horizontal action, quit the water without lifting it, or producing any sensible commotion behind. After a great variety of experiments, he found that a paddle wheel of one half the width and weight, and with trapezium floats, was as effective in propelling a vessel as a wheel of double the width and weight with the ordinary rectangular floats. The Admiralty had permitted him to fit Her Majesty's steam ship *African* with these wheels, and he had perfect confidence in the success of the experiment. Another means of propulsion was the screw, which had been applied with success by Mr. Smith in the *Archimedes.* In examining the wings of birds and the tails of swift fish, he had been particularly struck with the adaptation of shape to the speed of the animals. The contrast between the shape of the tail of the cod-fish, a slow moving fish, and the tail of the mackerel, a rapid fish, was very remarkable,—the latter going off much more rapidly to a point than the former. From these observations he was led to try a screw with four wings, of a shape somewhat similar to these, but bent into a conical surface, the outline being a logarithmic spiral. He found also that certain portions of these might be cut off without diminishing the effect. With respect to ascertaining the friction of the screw on the water, great difficulty existed; but he would refer to his experiments, published some years ago in the Philosophical Transactions, in which he measured the friction of the water against a body revolving in it, by the time which a given weight took to descend; this body consisted of rings, and he found that the friction or resistance through the water did not increase in proportion to the number of rings.

"*On a Floating Breakwater.*" By Capt. Taylor, R.N.

The breakwaters hitherto constructed have generally consisted of solid masonry, thus presenting an unyielding obstacle to the waves, and permitting accumulations of mud and sand behind them, and not affording the security to shipping and life which is required, and may be afforded by other means. The floating breakwater consists of floating sections framed of timber, moored to piles; these sections yield to the shocks of the sea, and admit the wave to pass under, over, and through them, and by thus dividing the waves, reduce them to an open and harmless state. The forms of these sections vary according to the situations in which they are employed. The sea in the most tempestuous weather is said to be tranquil at the depth of sixteen or eighteen feet below the surface; a breakwater, therefore, immerged to that depth, and presenting six or eight feet above the surface, is sufficient to form a safe harbour on the most boisterous coast. The angle of inclination which the section presents to the wave is that pointed out by nature in the Mew-stone, viz. 35 degrees. Stone breakwaters check the ground tides, and cause accumulations of mud and deposits which otherwise would go seaward, and are peculiarly subject to the action of the teredo, constantly at work below the dove-tailed stone; and cavities being formed, large portions are occasionally blown up. The destruction by the teredo may be obviated or arrested in the floating breakwater by tarring the wood with a preservative mixture, or by restoring from time to time such portions as are injured. The distinction between waves and breakers is very important, the former being an undulation, the latter being accompanied with a translation of the mass, and capable therefore of exerting extraordinary forces on the masses opposed to them.

Some remarks were made on statements in another Section, respecting the destruction to which the limestone of which the Plymouth Breakwater is exposed from certain animals (*Saxicava rugosa*). These animals do not, however, meddle with granite, and probably timber payed over with hot tar would resist their ravages, as animals of this nature seem peculiarly averse to the smell of tar and similar substances.

"On Forms of Vessels."

Mr. Scott Russell reported the progress made by "the Committee on Forms of Vessels" during the past year. The object of the experiments is two-fold —to advance our knowledge of the laws of resistance of fluids,—and to obtain data for the practical improvement of the art of naval construction. Many and expensive are the experiments formerly made on this subject. Unfortunately, these experiments had been made with imperfect apparatus, or under circumstances different from the conditions of bodies moving on the surface of the water, or on solids of a form unsuitable to the formation of ships, or on so small a scale as to render them unworthy of the confidence of the practical constructor. In the present series of experiments a more simple apparatus was employed than in any former series of experiments. The forms of body experimented upon were those of actual ships, or bodies analogous to those in use: it was the object of the experiments to supply the actual desiderata of hydrodynamics and of practical ship building. The experiments were made on vessels of every size, from models of 30 inches in length to vessels of 1,300 tons. The experiments were also made upon vessels in water of variable depth and in channels of various dimensions, so as, if possible, to embrace all the elements of the resistance. A minute description of some of the apparatus was then given, along with some general illustrations; but as the experiments were still in progress, and to be continued during the following year, no general statement of results was entered into at the present meeting. It was expected that by the next meeting the whole would be concluded.

"On Captain Couch's Chock Channels."

Mr. Snow Harris explained and illustrated, by a model and drawings, the safety chock channel, for allowing the masts and rigging of vessels to be easily disengaged when the masts are carried away. Many cases have occurred in which, with the rigging and ordinary channels, the greatest danger has been incurred, in consequence of not being able to get clear of wreck. The ordinary channels may be blown up by the sea; whereas, if made solid, on Capt. Couch's plan, all danger from this source will be avoided, and the sailors would be at once able to clear the vessel of any wreck.

"On Arnott's Stove, and the Construction of Descending Flues, and their Application to the purposes of Ventilation." By J. N. Hearder.

The general advantages of Arnott's stoves in economizing fuel, avoiding smoke, and regulating the temperature, are well known; but these stoves are attended with some disadvantages, of which the danger of explosion, and imperfect ventilation, are the most serious. The liability to explosion, Mr. Hearder considers to arise from the construction of the stove, in having the door air-tight; the only aperture for air being the valve aperture of the ash-pit. The air so admitted is immediately decomposed, and nearly the whole of its oxygen is abstracted, so that by the time it has passed up through the fuel, and reached the upper chamber of the stove, it has not oxygen enough left to support combustion. The heat evolved by the lower stratum of fuel, acting upon the upper stratum of fresh or unignited fuel, liberates from it the inflammable gas which it contains, and which also accumulates in the top of the stove. A mixture is then formed analogous to the fire damp of coal mines, ready for explosion whenever the requisite oxygen or degree of temperature shall be present. Under these circumstances, should the door be opened, a burst of flame outwards may be the result; or should a puff of wind down the chimney carry the mixture down through the ignited fuel, an explosion may ensue. Other causes, such as the sudden shutting or opening of the doorofan apartment, may occasion the downward draught and consequent explosion. Now carburetted hydrogen will not explode when the proportion of the air to the hydrogen exceeds a certain limit, so that if air be supplied to the top of the stove, so as greatly to preponderate over the hydrogen, the latter will burn off in a flame at the moment of its formation, or be carried up the flue. Mr. Hearder, therefore, proposes as a remedy, perforations through the lower edge of the door, so that air may be admitted on a level with the top edge of the fire brick, through which a constant in-draught of atmospheric air will be insured, sufficient to obviate the evil. The heat evolved by the perfect combustion of this inflammable gas, under these circumstances, will, he says, more than compensate for the admission of cold air into the upper part of the stove. The perforations just mentioned will also obviate, in a great measure, the want of ventilation. The author suggests a small rarefying apparatus, to be inserted in the vertical shaft connected with a descending flue.

"Some Experiments showing the possibility of Fire, from the use of Hot Water in warming Buildings, and of Explosions in Steam Engine Boilers." By Mr. Goldsworthy Gurney.

After detailing several instances of fire which arose from the steam pipes of water apparatus used for warming houses, the author proceeds to describe some of the experiments likely to be of practical value. From a tubular boiler, driving a high pressure engine, the injection pump was cut off—half an hour after the supply pump was stopped, no water appeared on opening the gauge cocks, and the engine was observed to slacken its rate and to move sluggishly—it had dropped from 50 to 30 strokes a minute. The steam pipe from the boiler to the engine was 10 feet long, and was carried for convenience through the open air, thickly wrapped round with woollen cloth to prevent radiation: soon after the engine became sluggish, the woollen cloth was observed to char near the boiler, which soon extended along the whole length of pipe; the engine still working, but with more apparent difficulty, making only 16 strokes per minute; the pressure gauge, which usually ranged between 30 and 40 pounds, now stood at 15, and was gradually sinking. In about five minutes after the woollen cloth had charred, a lead flange, used as a packing at the cylinder joint, melted, and was followed by a loud escape of elastic matter. The engine stopped working, and on bringing a lighted match into the escapage, it took fire, and burnt with the lambent flame of hydrogen gas. The author's impression was, that the escaping vapour was not pure hydrogen. Water condensed on a piece of cold iron held in the flame, but no water condensed on the cold iron after the flame was extinguished. On examining the boiler, all the tubes were found red hot. This experiment was repeated with many modifications. The temperature of the escaping vapour was ascertained by means of bars, previously prepared to melt at different temperatures; these indicated a temperature of about 400°. In about eight minutes a piece of pure lead melted—woollen cloth was charred, and a piece of tow held in the escapage took fire. In other experiments it was found, that the pipes became sufficiently hot to explode gunpowder, and many chemical preparations. Having satisfied himself of this property of heated steam or elastic matter, formed from the last portions of water in a boiler, the author proceeded to examine, as far as possible, its chemical nature—to determine whether any decomposition, or new elementary formation, took place. He found that the elastic matter was not condensible over cold water, and would not in many cases burn, or show any indications of the presence of hydrogen, or other inflammable matters. In some experiments it was found it would extinguish flame. The experiments with copper vessels afforded the same results as those manufactured from iron. From these experiments it appeared, that whenever the heating apparatus falls short of water, the elastic matter formed over the fire will carry sufficient heat through close pipes, to any distance, to set fire to wood and other combustible bodies, and that whether the hot water apparatus be under pressure or not, or whether the heating surface be of tubes, plates, or cylinders. On the other hand it would further appear, from some experiments enumerated, that in no case is there danger when a given quantity of water is present. Mr. Gurney suggests, that if both ends of the circulating series in hot water apparatus, namely, the part which immediately goes from the heating surface beyond the furnace, and that part where the circulation returns to it before it enters the furnace, was made of a metal which would not melt at the fair working temperature of the water, but which would melt at a temperature of from 5 to 600° of heat (say lead pipe), there would be little, if any, danger from fire.

It was mentioned that some experiments made many years since, by Woolfe, on some of the boilers of the Cornish steam engines, corroborated the facts now stated. It was also mentioned by Mr. Hunt, on the authority of Capt. Tregaskis, that where the boilers had been covered with sawdust, it was found in some instances, and in a very short time, to be charred.

"Account of the Strata penetrated in sinking an Artesian Well at the Victoria Spa, Plymouth." By Dr. Edward Moore.

The author pointed out the mode by which the operations were conducted. The strata penetrated were as follows:—Earthy clay slate, 20 feet; limestone, 150; blue slate, 20; red sandstone, 3; red slate, 37; limestone, 50; sandstone, 4; red and blue slate, 30; dunstone, 8; earthy clay slate, 20; red sandstone, 12; making a total of 365 feet. The earthy slates were of the character of those generally found under the limestone, but they were interspersed with blue shillat slates, similar to those which occur above it. From the circumstance of the slate rocks immediately below the red sandstone being in each instance tinged red, the author imagined that their colour might in these cases, if not in all, arise from the iron of the red bands affecting them by percolation. He next remarked that from the alternations of slate and limestone, the former appearing, from a consideration of the section, to come up in wedges through the latter, it might be possible that the opinion that some of the Plymouth limestones might have been formed in a manner analogous to the modern coral reefs, was founded on correct data, although in many other localities in the vicinity the bands belong to the same uninterrupted series of deposits. The quantity of water obtained was at first considerable, and overflowed the pipe; at present it generally remains about two feet below the surface, from whence it is carried to the saloon by a pump; it is clear and sparkling, and of a saline taste; it has been examined by Professors Faraday and Daniell, and found to contain in the imperial pint 8·100 cubic inches of carbonic acid gas, and 151·66 grains of dry salts, thus:—

Chloride of Sodium	96·64
Muriate of Magnesia	18·68
,, ,, Lime	15·10
Sulphate of Soda	9·55
,, ,, Lime	8·94
Carbonate of Lime	2·06
,, ,, Iron	0·69
	151·66

Its specific gravity at 62° is 1013·3.

Prof. Sedgwick, after reviewing the general principle of Artesian wells, described two districts in which these operations were attended with very different results. In the eastern part of Essex the chalk is covered by sandy beds of the plastic clay, and these by several hundred feet of impervious strata of London clay, all dipping together towards the east. The arenaceous beds below the London clay rise higher towards the chalk than the clay does, and absorbs a considerable part of the water from the high grounds. By boring through the clays to this sand, springs of water immediately rise above the surface, and are carried off by natural channels. By this supply of water, the value of the land has been materially increased, since the country, though abounding in peat bogs, and stagnant ponds during winter, suffers much from the summer drought. The other attempts to form Artesian wells, referred to by Mr. Sedgwick, were made near Lincoln, which, though surrounded by fens, covered with water in the winter, is not sufficiently supplied during the summer. But the clays supporting the fens of the Bedford Level are below the chalk, and though there are pervious beds beneath them, which rise to the north-west, yet the clays are of such enormous thickness that they have never been penetrated; and even were that accomplished, the high land is so distant that intervening fissures, filled up with impervious materials, might intercept the supply. Expensive sinkings have been made at Lynn, and also at Boston, and after boring through many hundred feet of clay they have utterly failed, and in any future operations in this district the chance of success would be very remote. Mr. Sedgwick then observed with respect to the red colour of rocks mentioned by Dr. Moore, that he considered it simply owing to the red oxide of iron which might be present or not in any bed; sometimes the tinge was only superficial. In Nassau the red colour was owing to vicinity of trap rocks. He also observed, as to the condition of limestone rocks, that although they sometimes appear in masses, presenting a brecciated appearance, shells and broken corals being cemented together, yet generally they occur as regular parts of the series repeated without any regularity, in formations of all ages. In position and inclination they resembled their associated rocks, and partook in all their contortions and dislocations, except so far as their solid masses would resist mechanical movements, better than yielding deposits of sediment and mud. The organic remains found in limestones only differed from those in the other beds of the same age as far as the conditions differed under which each was deposited. At the present day different families of corals grow upon a solid and a soft bottom.—The Rev. W. D. Conybeare pointed out the similarity between Artesian wells and mines sunk in the coal measures. Artesian borings had been made with success near the outcrop of certain strata, but at a distance from this, although the combination of strata was the same, they had failed, from the great depth necessary to be penetrated. Now it is certain that the coal exists in many places beneath the new red sandstone and magnesian limestone, but at such depths that it would be hopeless to attempt to reach it. He therefore recommended to the attention of miners the formation of a series of Artesian borings in some of the coal districts, beginning where the probability was greatest, and proceeding from that point till the depth became too great. Such a series of experiments would show the nature and depth of the strata below, and over what extent coal might be worked without sinking shafts at enormous expense and with the risk of complete failure.—Mr. Bartlett observed, in confirmation of one of Dr. Moore's remarks, that where limestones abounded in corals, as at Berryhead, their structure was homogeneous, and exhibited little trace of stratification; when the corals were rare, the bedding became distinct.

"*Some Inquiries into the Causes of the increased Destructibility of Modern Copper Sheathing.*" By Mr. Prideaux.

In May 1840 Mr. Prideaux was applied to by Mr. Owen, of Her Majesty's dock-yard, to analyse some sheet copper from the sheathing of the *Sanspareil*, which had been on thirty years, and was still in good condition. The sample gave about 0·25 per cent. of alloy, chiefly zinc and tin. This contrasted well with a sample rendered unserviceable in a very short time (in only one year), and in which no quantity of alloy sufficient to weigh had been found; and the two agreed with two recorded analyses of Sir H. Davy and Mr. R. Phillips, the former having detected, in a very good sample of sheathing, about $\frac{1}{400}$ of tin; the latter having found the sheathing of the *Tartar* frigate (almost destroyed in four years, though never out of Sheerness harbour,) the purest copper he had ever analysed; and further with the reputed inferiority of the recently prepared sheathing of the Royal Navy, which must have been much purified by the repeated fusions it has undergone. The inference adduced was, that the presence of tin and zinc was favourable to the durability of the copper. Mr. Prideaux, however, proceeded with the analyses in other cases. Four were selected, viz.

From the	Copper on	Annual loss.
Minden	17 years	0·45 per cent.
Plover	only 5	11

Linnet, copper rapidly destroyed, could not be taken off sound enough to weigh a sheet.

New-sheathing prepared at Her Majesty's mills, Portsmouth.

There was no conformity between the results in these and the former experiments; they did not show any coincidence between the composition of the sheathing and its durability. The next step, therefore, was to examine how far it might be referred to any of the physical properties of the metal. To ascertain this, slips from each sample, all of equal surfaces (4 + 0·5 inch), were immersed each in a pint of sea water: the five vessels being placed side by side, so as to set them all in like conditions. Sea-water being electro-neutral, and acting *slowly* on copper, a little sal-ammoniac was added, to quicken the action without affecting the neutrality. The greatest waste was on the *Sanspareil'* copper, which had worn the best of all; the least on that of the *Plover*, one of the worst. Thus, in the laboratory, under parallel circumstances, they do not observe the same order of durability and waste as they had done in use. The cause of comparative waste appears, therefore, to be in part at least, due to *external conditions*, and of these two classes may be noticed: one depending on the connexion with the ship, the other on the circumstances of her employment. Of the first class two suggested themselves—the position on the ship's side, and the nails by which the copper is fastened. The lower part of a ship's copper seems to suffer much less than the upper, so long as she continues in deep water; but when she grounds at low water, if on black mud, this part suffers most from the action of sulphuretted hydrogen, peeling off in blue flakes. The influence of the nails offers rather more chemical interest. They are never of pure copper, and being very numerous, all in contact with the copper sheets, whilst their heads present also a considerable metallic surface to the salt water, they may produce very decided effects, either preservative or destructive, by a slight electro-chemical difference. Mr. Prideaux therefore examined a vessel which they were just then stripping, her copper being worn out in four years. It was found that round some of the nails the copper was quite entire, for an inch or two, though worn ragged in other parts; whilst elsewhere, and sometimes on the same sheet, the copper round other nails was quite gone, though other fragments of the sheet remained. Here some of the nails appeared to have exerted a protective, others a destructive influence. To ascertain the effect of the nails, five slips of new copper from the same sheet, and of the same size, were suspended equidistant, and at the same depth, in a vessel of sea water from the West Indies. The result was, that all the nails, except one (which was from Her Majesty's dockyard), appeared to act destructively. Here appears to be *one* instance of a protective nail, not enough so to prevent all waste of the copper, which experience has shown not to be desirable; but doubtless the preservative power may be increased to any requisite degree by attending to the composition of the alloy. The copper is alloyed chiefly with tin; but if the nail is at once hard and flexible the manufacturer is satisfied without examining what other metals are present. If they were always made just so much electro-positive to the copper as to protect the sheathing, so far as compatible with their own durability, they would seem to offer the simplest, most perfect, and most convenient means of electro-chemical protection. The damage to which the copper is subjected is affected by the circumstances of the ship's employment. Sheathing suffers most where most subject to wash and air, for friction is an agent in the waste as well as oxidation. It is also well ascertained that the copper sheathing suffers most in hot climates, which might be expected, upon a common chemical principle, that chemical action increases with the temperature; and it became a question whether this effect of heat, as well as its tendency to promote organic production and decomposition, might not form an important element in this destructive agency. Mr. Prideaux therefore obtained water from different parts of the Gulf Stream, with and without the weed, from the Caribbean Sea, and from Falmouth harbour, where the packets moored, the waters of which might possibly be affected by the mine drainings discharged into the river. Whilst these were being collected, Prof. Daniell's announcement of large quantities of sulphuretted hydrogen in the waters of the Guinea coast came before the public. To try the action of these different waters five copper slips, of the same dimensions, cut from the same sheet, were suspended in a pint each of the following samples of water:

1. Heart of the Gulf Stream.
2. Ditto with the weed.
3. Caribbean Sea.
4. Falmouth harbour.
5. Plymouth harbour.

After thirteen days they were taken out and reweighed, having been put in all bright, but cleaned, on taking out, only with a brush in soft water, as in the other experiments:—

	1.	2.	3.	4.	5.
Put in 16th........	180·26	182·56	190	169·01	176·41
Out 29th	178·45	182·3	189·6	168·55	176·1
Loss in 13 days....	1·81	0·26	0·4	0·46	0·31

No. 1, came out clean and bright, the others with tarnished surfaces, except No. 2, which was blotched and speckled. The Falmouth water presented no indications of being more corrosive than that of Plymouth, and Mr. Prideaux attributed the great difference of waste in these two cases to same unobserved difference of conditions in the experiment. But the excessive action of the Gulf Stream water, he considered too decided to be doubtful. Not only the quantity wasted, but the metallic clearness of the surface, showed a marked distinction. "But to whatever extent the recently increased waste of sheathing may fairly be charged upon the greater velocity, more constant employment, and greater consequent liabilities of weather and climate of our ships, particularly of the commercial classes, as well as to difference in the nails, I am inclined," said Mr. Prideaux, "to fear the fault is still to be sought in the copper itself. I have it on the authority of Mr. Moore, that the *Quarantine* cutter, generally at anchor in our harbour, was coppered in October 1832, and her copper is now in a very good state. Her last sheathing held good 14 years. The Eddystone tender, which also moors in Catwater, was coppered in July 1838, and is now in much worse condition than the *Quarantine*, which has been on six years longer. That the waste on the Eddystone tender is not owing to her work, is evident, from the fact, that the upper part of her sheathing, which suffers the wash and friction, continues sound, whilst from beneath her floor the copper peels off in blue flakes. That this is attributable, in a great degree, to her occasionally grounding upon the black mud, which generates sulphuretted hydrogen and other corrosive matters, is very probable; the other never grounds, and does less work. Yet the difference is too great to be thus satisfactorily accounted for. The one is in good condition for nine years, the other comes to patch before the end of three: both lying the most of their time in the same harbour. On neither was there any distinct indication of protective or destructive influence in the nails." "Meanwhile, as nails must be used, and present a large metallic surface to the salt water, as well as numerous points of contact with the copper, calculated to give great effect to small electro-chemical differences, either in protection or destruction, it would seem that we ought to render them slightly electro-positive to rolled copper, by the addition of zinc, which would not injure their flexibility nor enhance their cost. The test, by the galvanometer, would be easily applied (after a little practice) in making up the metal for casting them, if it is of importance to continue the present system of their manufacture."

There is another method of protection, which came out in the course of these investigations; and which is beginning to occupy public attention. It was before noticed, that the upper part of the copper on the Eddystone tender, which bears the wash and friction of the waves, continues sound; whilst the bottom is fast wearing out. This exception, or rather subversion of the usual conditions, is owing to a coat of fish oil, laid on when the copper was new, to keep it bright; and not extended over the parts out of sight. Such a permanent effect could never have been anticipated from an oil which is not drying, and strongly indicates the facility, as well as efficacy, of this mode of protection. A still more striking case presented itself in the vessel which supplied the observations on the apparent influence of the nails. During our examination, we observed the complete preservative effect of some coal tar, which had trickled down over the copper, from the wood-work above. This had crossed the sheets just where most subject to the wash and friction; and whilst the naked metal had been quite worn away, the coal-tarred streaks remained entire, the surface of the copper, on melting off the tar, being as perfect as when fresh from the roll. Hence coal tar seemed to be an efficient preservative; but then recurs the question—will it keep a clean surface, free from organic adhesions and earthy incrustations? To embrace the opportunity for experiments, the vessel was sheathed with copper on one side and yellow metal on the other; and her fore-quarters to her mid-length varnished with coal tar, laid on hot, upon the metal also heated, by fires of chips round the sides. She has now been twelve months at sea; and, according to the last account, the varnished as well as the metallic surfaces, kept quite clean.

METHOD OF PREVENTING THE OXYDATION OF IRON.

By M. F. L. Allamand.

This composition, of a metallic nature, preserves iron and steel from oxydation, by entering into the pores without in any degree affecting their external appearance, or leaving the least blemish, so that steel instruments (including razors), fire-arms, &c., retain their polish, and are in some degree better fit for use, after having been subjected to the metallic application. Articles either plain or chased appear superior to platina, and retain, after the application, all the hieroglyphic characters, figures, letters, and other engravings, or cuttings, which were there previously.

COMPOSITION OF THE MATERIAL.

Pure Malacca Tin	120
Silver filings	4
Yellow tincal	12
Purified Bismuth	12
Purified Zinc	12
Regulus of Antimony	4
Nitre	11
Salt of Persicaria	1

Method of Purifying the Metals.—The tin ought to be melted separately 18 times. Each melting should remain about 20 minutes exposed to the action of caloric, and the impurities which arise on the surface should be carefully removed; it is thrown afterwards into a ley formed of vine twigs and persicaria (herb) in equal proportions. The bismuth, the regulus of antimony, and the zinc are also melted separately, but they only require it twice, and they are carefully run into an ingot mould, so that all impurities may remain at the bottom of the crucible. The tincal does not require any purification.

Mixture of the different substances.—The tin is the first material that is melted; the silver is afterwards added to it in small quantities, and in a few minutes afterwards the tincal, then the bismuth and the zinc in succession. As soon as it ascertained by the flames that the alloy is effected, the two kinds of salt are thrown in together, and are left to burn with vigour, and the alloy is stirred with an iron rod; after which it is carefully skimmed and poured into a vessel, to be made use of for the metallic application.

Method of applying the substance.—Before the piece of iron or steel is dipped in the recipient which contains the metallic mass already liquified, its surface must be rubbed well with a composition of sal-ammoniac and cream of tartar, in the proportion of 5 per cent. of tartar to the sal-ammoniac; the iron must then be dipped in the melted alloy, where it must remain only for a few seconds, and till it is perceived to be covered with a certain quantity of the metal. It is next placed in a wooden box of its own size, and in which there has been previously put a small quantity of sal-ammoniac and cream of tartar, in the proportions already indicated. It is again rubbed with a handful of tow, and a small quantity of the powder is put on the surface. In the course of this operation the steel loses its colour, and assumes that of silver. When this is done it is again plunged into the metallic mass for a few seconds, and when it is taken out it is again lightly rubbed with the tow to remove any superfluous particles. The article being perfectly clean and shining, it is plunged into a basin of cold water, into which there has been poured a bottle of spirits of wine of forty degrees of strength, in the proportion of ½ per cent. After having withdrawn it from the water, the article is rubbed carefully with a linen, then it is rubbed as carefully with some fine sand, that has been moistened, to remove the spots of smoke: it is at last rubbed a second time with dry sand, then with a linen, and finally with a leather. After all these operations, which require great celerity in the execution, the iron will remain impervious to oxygen, and by care it will preserve all its whiteness.—*Inventors' Advocate.*

APPARATUS FOR DISTILLING SEA WATER.

We have seen in operation, at Mr. Robinson's manufactory, Pimlico, an apparatus for evaporating water in large quantities. An authentic account of the apparatus has been given in the *Inventor's Advocate*, from which we give the following details:—

The principle on which the patent "Distillator" is constructed, is that of the continuous transfer of heat through a series of vessels by evaporation. Thus, steam being generated in the boiler, is admitted into a chamber surrounded by water, where it is condensed, forming distilled water. From that chamber the water is permitted to run off into a suitable vessel. The heat transferred from the condensed steam to the water with which the condensing chamber was surrounded, produces renewed evaporation, and the steam from that second boiler is conveyed to a second condensing chamber placed in a third vessel of water. The process is repeated in that vessel, and may be so continued through five or six condensing chambers. In the apparatus we inspected at Pimlico there are only three condensing chambers, and the hot water in the last vessel is pumped back to the first boiler until it becomes saturated with salt, and then it is blown off.

As in the ordinary process of distillation only one condensing vessel is used, it is evident that a positive saving of fuel must arise from the addition of other vessels in which a similar process can be carried on without the addition of fresh fuel. In the apparatus already constructed, it is found that by the addition of two chambers to the ordinary still, an increase of distilled water is obtained equal to from 130 to 140 per cent. The produce of the three condensing chambers, at a *minimum*, are three measures from the first, two from the second, and one from the third; the two last being equal to the evaporation from the boiler heated by fuel. At a *maximum* the quantities are: from the first, five measures; from the second, four; and from the third, three. This is equal to a gain of 140 per cent.

In the report of experiments made to the Lords Commissioners of the Admiralty, it was proposed to produce 20 lb. of distilled water by the combustion of 1 lb. of coals. This was actually produced by the apparatus, under a working pressure of steam in the boiler of 10 lb. to the square inch; but, as in subsequent trials, the working pressure has been reduced to 5 lb. the square inch, as a measure of safety, the effect falls short of 20 lb. of water for 1 lb. of coal, in a slight degree; but in a new apparatus, this can be amply compensated, by giving an increased evaporative power to the first boiler of the series, and by coating the whole with felt, so as to prevent the radiation of heat. In a trial of three hours duration, 59 gallons were evaporated from the three vessels as now constructed.

It is proposed, as a matter of convenience and safety, when the apparatus is employed on board ship, that the fire should be placed on the upper deck, and the distilling or condensing chambers on the lower deck, or in the hold. By this arrangement it is expected that the same fire which is used for cooking may be made the means of producing a constant supply of fresh water.

By the use of this invention, the necessity of encumbering a vessel with the usual cargo of water and tanks for a long voyage is entirely obviated, by merely substituting five per cent. of that cargo in coals for the distillation.

FRESCO PAINTING.

Mr. Haydon, with characteristic energy and enthusiasm, has made a trial in fresco, on the wall of his painting room; and the result of this first and hasty attempt is decisive of two important points—the beauty of fresco painting as a means of decoration, and the ease with which a knowledge of the practice may be acquired. The subject is a study for the archangel Uriel, the bust and arms only, of the life size; it was painted at once on the plaster, without a cartoon to work from, in four hours; the painter's hand trembling with apprehension for the success of his experiment, and incompetent from inexperience to do full justice to the means. It is a rough sketch, in short, made without the boldness and firmness of pencilling that certainty of purpose and mastery of hand alone can give. Yet the figure stands out from the wall, solid in form, lively in colour, and brilliant in tone, making the pictures beside it look poor, flat, and muddy in comparison; its flesh tints surpassing in purity the freshest oil painting. It has a majestic presence, that seems to enlarge the space it occupies, and to give new radiance to the light reflected from it; but while it thus fills the sense and elevates the mind, it is not obtrusive. In describing the impression made by this piece of fresco, our object is not to compliment Mr. Haydon, or to praise his design. We do but record the effect produced upon us by the work; though the conception and style of the painter must have had their share in producing this impression, we endeavoured to regard only the physical qualities of the art. The large scale of the design and the breadth and simplicity of the painting, have unquestionably a material influence over the mind; but these characteristics belong to all fresco, and constitute its chief recommendations; the greatness of the style powerfully aids the grandeur of the idea, and the largeness and boldness of the handling inspire the painter with congenial vigour of execution, which the cartoon he works from would prevent from running into exaggeration. As the tendency of high finish in cabinet pictures is to contract the focus of the mind and cramp the execution, so that of fresco is to enlarge the conception and expand the style. Fresco painting is the school of greatness in painting; it daunts and depresses only the little mind; it fires and elevates the noble and aspiring genius; the artist works with that grand gusto of which we hear so much and see so little. Mr. Haydon tells us, and we can well believe, that there is a fascination in the very manner of painting which is inspiriting and stimulating to fresh exertions; and he now regrets not having followed the advice of Sir David Wilkie twenty years ago, to apply himself to fresco. Any zealous artist might easily make the experiment; the same means of information are open to all. The book authorities for the Italian method, we are told, are Vasari, Armenini, and Cennini. Messrs. Latilla, of London, Bell, of Manchester, and Barker, of Bath, are the artists in this country whom Mr. Haydon consulted; Mr. Lane, of whom we spoke, is not, we believe, in England. The method is simple; chip off the outer surface of the plaster from a dry wall, and substituse for it a coating of wet plaster, composed of two parts of river sand and one of lime, well mixed together with water to a proper consistency; this applied to the wall will remain sufficiently moist to work upon for four hour; no greater space should be plastered at once than can be covered in that time. Every touch is indelible; but it may be gone over again when the plaster is moist. The pigments used are of the common kind, being earths, and are dissolved in water; the lime itself is white; the difficulty is to allow for the change of tint in drying.—*Spectator.*

REVIEWS.

Illustrations of Arts and Manufactures. By Arthur Aikin, F.L.S., F.G.S., &c., late Secretary to the Society of Arts. London: Van Voorst, 1841.

Arthur Aikin is the scion of a literary house prolific in respectable names—we need only mention Dr. Aikin, Lucy Aikin, and Mrs. Barbauld. For a long while he was, as Secretary of the Society of Arts, the friend and adviser of the majority of the mechanical world, and well did he sustain his own position and the character of the institution. As a popular lecturer on subjects connected with the practical arts few could exceed him, for while he possessed the art of riveting the attention of his auditory, he was remarkable for a precision of idea and expression, which, even without the aid of diagrams or engravings, enabled him to give complete and correct ideas of most intricate and complicated machinery. So well was this known to be Mr. Aikin's characteristic, that Lord Brougham, himself no mean authority, is reported to have recommended a friend to apply to Mr. Aikin, as he knew "no other man but he who could make a specification without drawings." When Mr. Aikin retired from the post, which he had occupied so long, it was to the general regret, but still we hoped that one who had led a life so active and useful as his has been would not remain idle in his retirement, although he has well earned repose. We feel pleasure, therefore, in welcoming this first fruit of his retirement, which, as it is natural, is devoted to his ancient pursuits and connected with his former haunts. It is, what it purports to be, illustrations of arts and manufactures; it may, indeed, be considered as a manufacturing sketch or series of essays. The subjects treated on are pottery, limestone and calcareous cements, gypsum, furs, felt, bone, horn, &c., iron, engraving and paper. In their original form these papers were delivered before the Society of Arts, at their evening meetings, where we recollect the interest they excited; their republication therefore is likely to prove valuable.

From the article on pottery we have, at another page, given long extracts relative to brick-making, so that we cannot do better than here to take up the subject of limestones and calcareous cements. After tracing the origin of cement to brick-building countries, in the use of bitumen in the plains of Babylon. Mr. Aikin proceeds to allude to the improvements in its application which were made by other nations. To the Romans, however, he justly awards the palm among the ancients for their use of calcareous cements, on account of the extent to which they applied it in hydraulic works. They had also an advantage in discovering the use of puzzolana (vide C. E. & A. Journal, Vol. IV. p. 300.)* In alluding to the monuments of the Romans in this country our author says that the most ancient limestone quarries in this part of the empire, and which continue in full activity, were first opened by the Romans at Tadcaster, in Yorkshire, which, in the Roman itineraries, is named Calcariæ. In giving this praise to the Romans, it is to the Gothic style that we must refer the great extension given to the use of cement, the intricacy and elaborateness of its parts, its richness and multiplicity of ornament, not allowing the use of large blocks of stone. Limestones, Mr. Aikin divides after the usual arrangement into four classes. The first contains the pure limestones, including white statuary marble (which is of no use for mortar), white chalk, oolite, and gray limestone. In the second family are placed the swinestones and bituminous limestones, which are of value. Magnesian limestones come next, and lastly limestones containing so large a proportion of iron and clay as to enable them to form cements, which have the property of becoming solid under water, and are for this reason called water or hydraulic cements. (On this subject see also M. Vicat, p. 3 of our present volume). Among these are gray chalk, chalk marl or Dorking lime, found in large quantities at Dorking, Merstham and Halling: blue limestone, lying betweeen the lower oolite and the new red sandstone running across the country from N.E. to S.W. from Whitby to Lyme Regis, sending out a branch to Monmouth and Glamorgan. The entire thickness of this deposit is 450 feet, and among its chief quarries are Watchet, Aberthaw, Barrow and Bath. In the three former, according to Smeaton, the proportion of iron and clay appears to be the same, or about 11 per cent., but in the time of Barrow, according to that authority, 21·3, but according to Mr. Marshall, 11. In the upper and lower beds of the lias formation, and in all deposits of bluish slaty clay containing carbonate of lime, are balls of a compressed globular figure, less clayey than the slate marl, but less calcareous than the limestone. In the London basin these balls in the blue clay are called septaria or cement stone. They may be observed in the cliffs of London clay forming the eastern coast of the Isle of Sheppey, and in the low cliff at Southend in Essex. They were met with frequently in the cutting for the Highgate Railway and Primrose Hill tunnel. Of late years these stones, burned and reduced to powder, have been very extensively used under the name of Roman cement, in all water building and other masonry requiring particular care, with such success as to have entirely superseded the employment of puzzolana and terras. These two materials should also be noticed; the first comprehends a few calcareous substances, the essential ingredients of which appear to be oxide of iron and burnt clay; the latter is quarried at Andernach on the Rhine for millstone, and the fragments are ground up in Holland, and mixed with lias lime to form a cement for dykes and other works of the water-staat. In England, Rowley rag, a basalt obtained from the Rowley Hills in Warwickshire, and in composition similar to the Andernach stone has been used for the same purposes with good effect. The Egyptians, as it will be seen under the head of Ancient Engineering, used black basalt from Abyssinia. With regard to sand, the use of pit-sand is objected to unless previously cleaned by washing, but sand having a yellow colour, caused by ochre, and having chalybeate springs rising from out of it, will produce a cement of great hardness, provided that it be used soon after it is dug. But limestone and sand are not enough of themselves: the limestone must be deprived of its carbonic acid, and used as soon as possible, as it reabsorbs carbonic acid from the atmosphere. When packed in close casks, lias lime will keep good for a long time, and Smeaton's experience goes as far as seven years, but in this case, the lime was previously reduced to powder by slacking with water, and then was trodden down into the casks. The lime having cold water poured upon it, becomes hydrate of lime or slacked lime, and in this state and not that of pure lime, enters into the composition of mortar. The proportion of sand in mortar depends partly on the fineness or coarseness of the sand itself,

* It was an ancient law in Rome says Pliny, that after the ingredients of mortar had been rubbed together with a little water, the mass should be kept in a covered pit for three years before being used; and we are expressly informed that buildings erected during the operation of that law were not liable to cracks.

and partly on the nature of the lime, but on account of the cheapness of sand there is always a disposition to deteriorate mortar by a too liberal employment of it. The proportions given by Pliny are 1 of lime to 4 of sharp pit-sand, and 1 of lime to 3 of round grained sand from the sea or river, an improvement, he says, may also be made by the addition of a third part of pounded tiles. The common London mortar is made of one part of white chalk lime and 2½ of clean sharp river sand, but not unfrequently, dirty pit-sand is substituted, and the lime itself, being imperfectly burnt, the mortar never becomes hard, and has not sufficient adhesion to the bricks. White lime, when really good, will take a larger proportion of sand than the brown limes do, but it is an additional proof of the badness of common chalk lime, that in the London practice the reverse generally prevails.

Upon the question whether any chemical action takes place between the lime and silica in mortar, Mr. Aikin admits that it is difficult to come to a decision, but he alludes to several facts which seem only explainable by the existence of chemical acts.

In enumerating the water cements our author states, on the authority of Vitruvius, that the cement used by the Romans in the construction of moles and other structures in the sea, was one of lime and two of puzzolana, from which the proportions of Mr. Smeaton's cement, used in the construction of Eddystone Lighthouse do not materially differ, namely, equal quantities of Aberthaw lime in the state of hydrate and in fine powder, and of puzzolana also in fine powder; the cement was also well beaten till it had acquired its utmost degree of toughness. The Dorking gray chalk is used in proportions of 1 of lime to 3 or 3½ of sharp river sand; and for filling in the interstices of thick walls, 1 of lime to 4 of coarse gravelly sand. In setting the bricks, that form the facing of the London Docks to the depth of 14 or 18 inches from the outside, a cement was used of 4 lias lime, 6 river sand, 1 puzzolana, and 1 calcined iron stone.

This sketch of Mr. Aikin's mode of treating one subject will be sufficient to give an idea of the work, which we leave with the conviction that it is one highly useful and instructive.

Letter from Sir Frederick Trench to Viscount Duncannon. London: Ollivier, 1841.

In this letter Sir Frederick proposes a railway from London Bridge to Hungerford Market, to run in the river parallel to the northern bank. This is to consist of an embankment one mile and three quarters in length, faced with stone or plates of cast iron to imitate stone; on this, 4 feet above high water Trinity mark, is to be a promenade, bearing on iron columns, 13 or 14 feet high, a railway thirty feet wide, to be worked by fixed engines on wooden rails. At intervals in the embankment are to be arches for the passage of barges. The embankment, railway and all, as far as we understand is intended to pass under the arches of the bridges. With regard to the bed of the river between the channel and the shore. Sir Frederick proposes to leave it as a space for a carriage road, wharfs, warehouses, houses, docks, or open mud banks as the case may be. The estimate given on the authority of Mr. Bidder and Sir Frederick Smith is, for the embankment £110,000, elevated platform £100,000, machinery £70,000, stations £25,000, interest £30,500, for filling carriage road, paving, lighting and sewers £100,000. Total £435,500. The time for the works is calculated at two years.

Sir Frederick urges the necessity for an embankment on account of the changes made by London bridge and the embankment before the new Houses of Parliament, from which he says have resulted a great increase of shoals, and the production of a number of mud-banks covered with vegetation, and in a pestilential state of decomposition. These are evils which are but too apparent, and it is evident both as a measure of health, commerce, and ornament, that some plan of embankment should be adopted, whether Sir Frederick's, Mr. Walker's, or Mr. Martin's, we do not say; but we feel sure that the day is at hand when a great and general improvement will be effected on the metropolitan river, and placing it on a par with its Parisian and Dublin rivals.

To the plan of Sir Frederick Trench there are many objections, and some, and not the least, are those suggested by considering it as a plan for the adornment of the metropolis. Passing, as this railway proposes to do, through three bridges and touching a fourth, it is evident that it will not only abstract from the grandeur, but absolutely spoil the view of those noble monuments, without any adequate compensation. The view of Somerset House will not be improved, and St. Paul's will be the only edifice which will derive any advantage, so that on that ground we fear that any measure so extensive is inexpedient. How the railway is to pass under the bridges we confess we do not see, and as to passing over them, it is out of the question A stronger objection is as to the effect such an embankment will have in producing depositions of silt and off below Woolwich, which may be looked upon as a certain result. As to the estimates, although a good foundation may in most places be obtained, we are decidedly inclined to think that they are too low.

We are willing, however, as we before said, to support some plan of embankment, but one so general we do not think under all circumstances is applicable. That the terraces of the Temple, of Somerset House, of the Adelphi, and of Hungerford Market, should be united, we are ready to admit, but we are well aware that there are great difficulties in the way. As to the consideration of making a profit from the undertaking, we think that they need not be taken into account on the present occasion, for the urgency of some plan of embankment is such that the funds must be furnished regardless of any other objects than the public benefit to be effected.

In thus dissenting from the details of Sir Frederick Trench's plan, we cannot do so without expressing how much the public are indebted to the gallant General for the great exertions he has made for the improvement of the Thames, and how much the successful result will be owing to his counsels and active co-operation.

CANDIDUS AND THE VENTILATION FOLKS.

"Cease rude boreas, blust'ring railer."

This humble petition is addressed to Candidus, who last month took out "a licence to blow on whom he pleases." We pray that he may abate his sweeping gale against the "ventilation folks," who most humbly acknowledge their fault in daring to acquaint the public that carbonic acid gas from a chimney—or sulphuretted hydrogen from a drain, do not strengthen the lungs, refresh the nerves, and invigorate the constitution. We will say with Candidus that the vocation of a tailor is more conducive to longevity than is that of a ploughman—that there is real salubrity below deck under London Bridge—even that a cargo of slaves enjoy the most refreshing change of air, and that their sickness and death of 50 in a hundred, is a proof of their sullen ingratitude to their owners. We will say that the metropolitan improvement trustees are egregiously in error not to consult Candidus. That old London may be revived with its neighbour-like projections, its lanes and alleys, so contributary to disease; its overground kennels, its annular visitation of plagues and pestilence, its lamentations and cries, bring out your dead; we will turn all serious proofs of modern blessings into frivolity for a month. We will say with Candidus, that the great orb of day, "is sun or moon, or a penny rushlight," to appease his anger; and when in cool reason he will debate upon this question upon which we live and die, "we will argue with him upon this theme until our eyelids will no longer wag."

Some of the Ventilation Folks.

THE NEW ROUTE TO INDIA BY THE EUPHRATES.

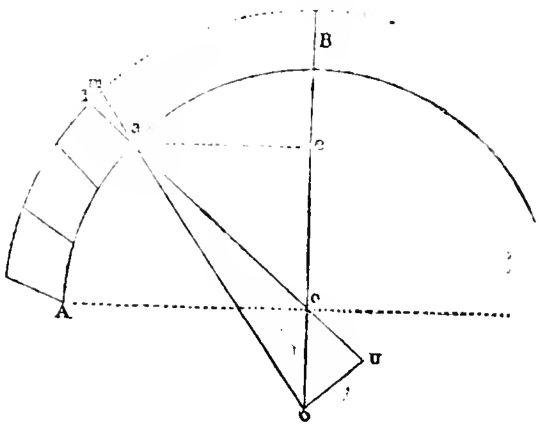
The *Commerce* publishes some private correspondence dated Aleppo, June 10, 1841, which states that the English steam boats Nimrod and Nitocris had arrived at Beles, on the Euphrates, after a navigation of 16 days and a distance of 375 leagues. Lieutenant Campbell, who commanded the expedition, had ascertained that both the Tigris and Euphrates are navigable for large vessels, and that those rivers present a new passage to the British possessions in India. "Documents stolen from M. Lascaris at Alexandria, in the year 1814," continues the writer, "contained important information collected by this gentleman. who was despatched by the Emperor Napoleon to explore Mesopotamia and the Euphrates, in order to ascertain the possibility of discovering a passage to India by the Orontes. The British Ministry determined to verify those plans. Colonel Chesney was deputed on this mission in the year 1835. Great Britain then ascertained that the Orontes. which falls into the Mediterranean, was navigable as far as Latakia (the ancient Antioch). That the ancient harbour of Selencia, situate at the mouth of this river, could be rendered an excellent harbour at a small expense. That it was easy to make a road to Aleppo, and thence to the Euphrates through the valleys, and that the distance, 45 leagues, could be easily traversed. A coal bed was discovered at the foot of Mount Taurus, 16 leagues from Tarsus. Near this coal bed, which is of considerable extent, has been discovered an iron mine, which gives 60 per cent. of metal. These mines are surrounded by oak woods of great value.

The writer calculates that the journey may be made from Bombay to Liverpool in 34 days—viz., from Bombay to Beles 16 days; from Beles to Alexandrette, 3 days; thence to Liverpool, 15. The letter concludes by stating that there is no doubt but that in a few years the English will monopolize the trade of Bagdad, Bassora, Aleppo, and all Mesopotamia.

ON THE CONSTRUCTION OF OBLIQUE ARCHES.

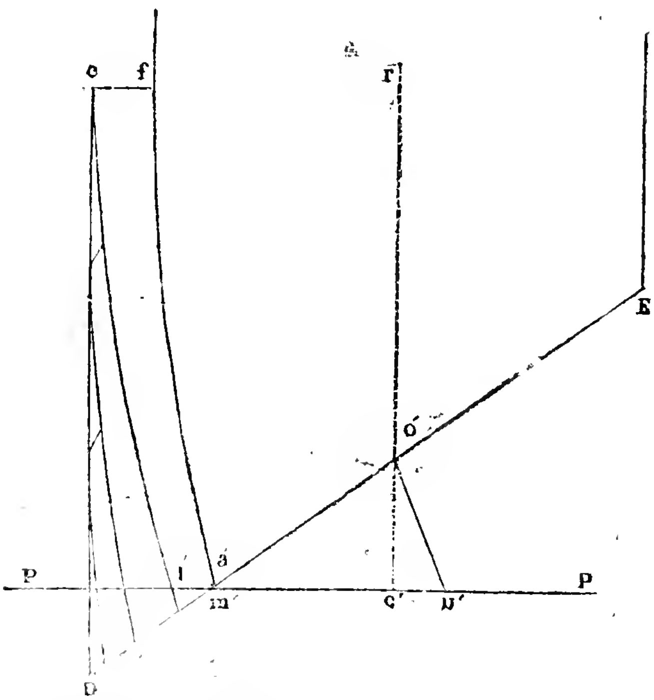
Sir—In compliance with the request contained in your letter of the 10th, I forward you the method by which the formula and construction given in your last number, for finding the angles between the joint lines in the face and soffit of an oblique arch, were obtained. The approximations thus arrived at are as accurate as it is possible to work to, the discrepance being much too small to be detected practically. As the subject is somewhat complex, I must be excused if the explanation here given is not strictly mathematical, the deductions however will be found correct.

Fig. 1



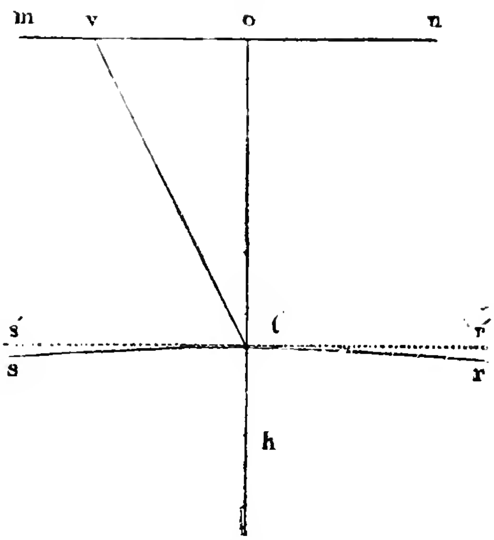
Let A B (fig. 1,) be the elevation of an oblique arch, on a plane at right angles to the axis of the cylinder on which it is formed, and let c be the centre, and *a* the point at which any joint *a m* in the face of the arch meets the intrado.

Fig. 2.



Let C D E (fig. 2,) be the plan of the same, (part of the arch being supposed to be removed), and let *a'* be the position in plan of the point *a* (fig. 1.) Suppose a vertical plane P P to pass through the point *a'*, intersecting the spiral surface *c f a' m'* in the line *a' l'*. From *l'* let *l' m'* be drawn a tangent to the spiral line of the extrado meeting D E in *m'*. And because the plane P P is perpendicular to the axis of the cylinder, the line of intersection *l' a'* will be a straight line at right angles to the tangent *l' m'*. The triangle *o' l' m'* is therefore the projection of a right angled triangle; and in the short distance *l' m'* the tangent very nearly coincides with the plane of the spiral surface, hence the angle *l' a' m'* will be a very close approximation to that formed between the chord of the curved joint in the face and the line *l' a'*; which is the angle represented by *v t o*, fig. 3, and that which it is required to find.

Fig. 3.



From *o'* where the axis intersects D E in plan draw *o' u'* parallel to *l' m'*, meeting P P in *u'*, produce *r o'* to c'. In fig. 1 let *l a* be the projection in elevation of the line *l' a'*; join *a c* and produce it to *u*, making *l a* : *a u* : : *l' a'* : *a' u'*. Through *u* draw *u o* at right angles to *a o*, meeting the vertical line B *c* produced, in *o*; and through *l* draw *l m* at right angles to *a l*, meeting *o a* produced, in *m*.

From the nature of the spiral surface it follows that *l a* and *a u* will be in the same straight line, and without going through the detail of each part of the construction, it will be seen that the triangle represented by *a o' u'* in plan, and *a o u* in elevation, is a right angled triangle similar to, and in the same plane with the trangle *a' m' l'*, having the angle *o' a' u'* equal the angle *l' a' m'*. Also that the side represented by *a o* and *a' o'* is the hypotheneuse, and is the line drawn from the point where the joint intersects the intrado to the point of convergence of the joints in the face; and that the side represented by *o u* and *o' u'*, which is the perpendicular of the triangle *a u o*, is the hypotheneuse of another triangle whose perpendicular is *c' o'*, and the angle *c' o' u'* equal to the angle of extrado. In the construction given in your last number, it will be seen that these are the two sides made use of to obtain the angle *u' a' o'* = *l' a' m'*, but in the formula it is more convenient to work with the base of the triangle *a' u' o'*, which is the line *a u* in fig. 1, and represented by *a' u'* in fig. 2, for when we have given

$\angle$ C D E $= \theta$ the angle of obliquity.
$\angle$ $c'\ o'\ u' = \varphi$ the angle of extrado.
$\angle$ $a\ c$ B $= \lambda$ the angle from the vertical,
and $a\ c = r$ the radius;

then drawing *a c* at right angles to B *c* fig. 1,

(Fig. 1) $a\ c = r \sin.\ \lambda, = a'\ c'$ (fig. 2).
(Fig. 2) $o'\ c' = r \sin.\ \lambda, \cot.\ \theta.$
(Fig. 2) $o'\ u' = r \sin \lambda, \cot.\ \theta, \sec.\ \varphi =$ the perpendicular.
(Fig. 1) $o\ u = r \sin.\ \lambda, \cot.\ \theta, \tan\ \varphi.$
(Fig. 1) $u\ c = r \sin.\ \lambda, \cot.\ \theta, \tan.\ \varphi, \cot.\ \lambda = r, \cos.\ \lambda, \cot.\ \theta, \tan.\ \varphi.$
(Fig. 1) $a\ u = r + (r \cos.\ \lambda, \cot.\ \theta, \tan.\ \varphi) =$ the base.

$$\text{Therefore } \tan \angle\ u'\ a'\ o' = \frac{r \sin.\ \lambda, \cot.\ \theta, \sec.\ \varphi}{r + (r \cos.\ \lambda, \cot.\ \theta, \tan.\ \varphi)}$$

Separating the constant from the variable quantities, and calling

$r \cot.\ \theta, \sec.\ \varphi = a,$
and $r \cot.\ \theta, \tan.\ \varphi = b,$

$$\tan.\ \angle\ u'\ a'\ o' = \tan.\ \angle\ l'\ a'\ m' = \frac{a \sin.\ \lambda}{(b \cos.\ \lambda) + r}.$$

Hence if the arch be a semicircle on the square section, the expression for the angle *l' a' m'* at the springing will be $\tan.\ \angle\ l'\ a'\ m' = \cot.\ \theta, \sec.\ \varphi.$

From the above may be proved the existence of the property discovered by Mr. Buck, namely, that the chords of all the joints in the face converge to one point below the axis; for $c\,o$ the distance of that point below the axis (fig. 1,) will be $o\,u \times$ cosec λ.

And $o\,u = r$ sin. λ, cot. θ, tan. φ.

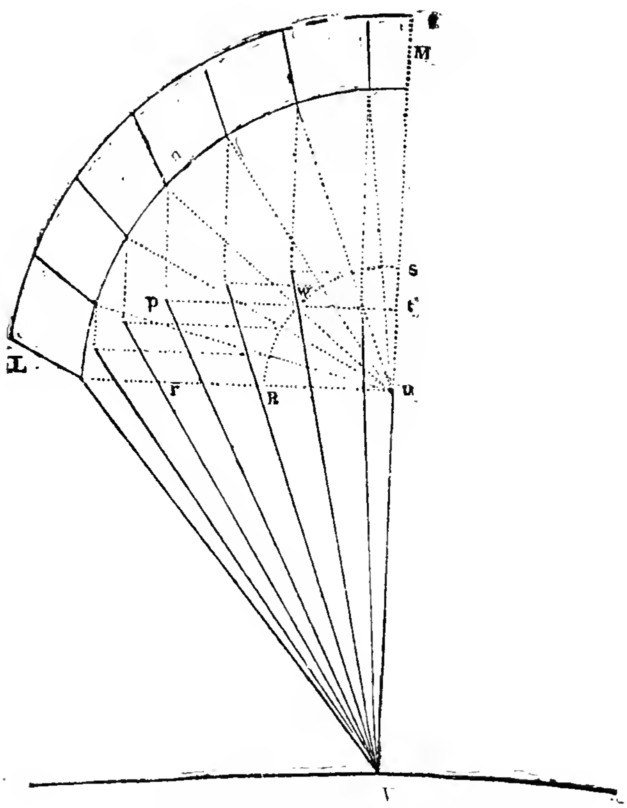
Therefore $c\,o = r$ sin. λ, cosec λ, cot. θ, tan. φ.

Whence the variable angle λ disappears, and $c\,o = r$, cot. θ, tan. φ.

This like the formula previously given for the angles, has reference to the line $m\,a$ (fig. 1,) and not to the true chord of the curved joint of the face; the approximation is however exceedingly close. If the angle of intrado be used instead of the angle of extrado, the results obtained by both formulæ apply to the *tangents* of the joint lines in the face, drawn from the points at which the joints intersect the intrado, and these results are *theoretically true*, though not available in the practical working of the case.

The formula tan. $\angle\, l'\,a'\,m' = \dfrac{a \text{ sin. } \lambda}{(b \cos. \lambda) + r}$ leads to another construction for finding the angles between the joint lines in the face and soffit which possesses some advantages over that already mentioned.

Fig. 4.



* The dotted line $n\,p$ should be produced to r, and V u produced to t—the dotted line $p\,t$ should be a full line.

Let L M (fig. 4) be the elevation of the face of an oblique arch, on a plane at right angles to the axis of the cylinder on which it is formed, $n\,u$ being the radius.

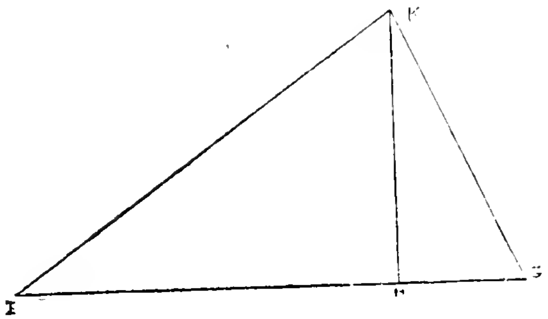
From the point K in the straight line K H, (fig. 5,) draw K F and K G, making the angle H K F equal the angle of obliquity of the arch, and the angle H K G the angle of extrado. Set off K G $= n\,u$ the radius, and through G draw G F at right angles to K H, intersecting K H and K F at H and F. Upon the vertical line M u produced (fig. 4,) set off $u\,v =$ F H, and from v with the distance H G describe the arc R W S. Then to find the angle formed out any joint n. Join $n\,u$ and through W where $n\,u$ intersects the arc R W s, draw $p\,t$ parallel to L u, and from n draw $n\,r$ parallel to M u, intersecting $p\,t$ in p. Join $p\,v$ and the angle $p\,v\,t$ is the required angle. For let F H $= r'$ and using the same letters for the angles as before.

$$\left.\begin{array}{l} \text{K H} = r' \text{ cot} \\ \text{K G} = r' \text{ cot. } \theta, \text{ sec. } \varphi. \\ \text{H G} = r' \text{ cot. } \theta, \text{ tan. } \varphi. \end{array}\right\} \text{fig. 5.}$$

$$\left.\begin{array}{l} t\,u = r' \text{ cot. } \theta, \text{ tan. } \varphi, \text{ cos. } \lambda. \\ u\,v = r'. \\ t\,r = r' + (r' \text{ cot. } \theta, \text{ tan. } \varphi, \text{ cos. } \lambda.) \\ \text{And } p\,t = r\,u = r', \text{ cot. } \theta, \text{ sec. } \varphi, \text{ sin } \lambda. \end{array}\right\} \text{fig. 4.}$$

Hence the ratio of $p\,t$ to $t\,r$ is the same as a sin. λ is to $(b \cos. \lambda) + r$, and therefore the angle $p\,r\,t$ is the same as that obtained by the formula.

Fig. 5.



The angles for the remaining joints being found in the same manner, and the mould of curvature of the spiral line of the intrado applied at V, the curved bevels or templates for all the voussoirs on both sides of the arch are at once obtained as shown in the figure.

I am, Sir, your obedient servant,

W. H. Barlow.

Brereton, September 17, 1841.

N. B. Will you be so good as to make the following corrections in my last communication.

In Fig 1 the letter A is omitted at the intersection of the lines E K and D C.

Fig. 4 should be Fig. 3, and Fig. 3 should be Fig. 4.

In Fig. 3 the straight line S T R should be S' T R'.

Page 292, line 3. For *draw G H* read *through E draw G H.*

THE NEW ROYAL EXCHANGE.

The contract of Messrs. Webb for the foundation of the new Royal Exchange was finished on Tuesday evening, and the Gresham Committee met on the 1st ult to receive tenders for the second contract, which is for the completion of the whole of the edifice.

Fourteen of the principal builders of London had, as we formerly stated, been applied to, and it was also determined that each tender should contain two prices—the one being for executing the mason work with the best Portland s one; the other, the additional price for using magnesian limestone, similar to that introduced at the Houses of Lords and Commons.

The amount of the several tenders were as follows. September 1. 1841 :—

Tenders	Portland. £		Magnesian limestone. £
Thomas Jackson..........	115.900	..	124.700
Baker and Sons	122.765	..	127.300
Henry and John Lee	126.390	..	131 900
Samuel Grimsdell	126.762	..	133.548
Grissell and Peto	127.400	..	132.000
Piper and Co.............	128,700	..	131.100
John Jay	129.609	..	1 4.905
John and Joseph Little ..	129.800	..	134.300
Webb and Co.............	130,150	..	131,150
Joseph Bennett	131,500	..	133,500
Bridger	131.519	..	138,660
William Cubitt	132.200	..	135.700
Nicholas Winsland	134.219	..	136,620
H. Ward	135.500	..	138.500

The tender of Mr. Thomas Jackson was, of course, accepted. The whole of the works are to be completed by Midsummer. 1844

The amount of the first tender for the foundations was £8121. See Journal, Vol. III. page 299.

Australian Steam Navigation.—Notwithstanding the wreck of one of the steamers, others have been sent out, and everything is now going on well.

Havannah.—A steamer has been started this month from Liverpool to Madeira, the West India Island and the Havannah

SHANNON IMPROVEMENTS.

We have much pleasure in noticing the very spirited and energetic manner in which the Commissioners for the improvement of the navigation of the River Shannon, are carrying into effect the powers vested in them by Government—besides the various works in progress on the lower Shannon at Kilrush, Kilteery, Killisart, and Foyn's Island, and in our immediate vicinity at Bannaroon, Plassy, and Killaloe. We learn that the same exertions are manifested to complete as soon as possible the numerous projected works on the middle Shannon, particularly at Meelick, Banagher, and Athlone, together with the important operation of dredging the bed of the river.

The principal feature of the improvements to be executed at Banagher, appears to be the erection of a new bridge over the Shannon, in place of the present old bridge, which measure has been found absolutely necessary, no less for the safety and accommodation of the public, than for the proper drainage of the country. The present bridge is built of rubble masonry, and consists of 17 arches of various dimensions, the piers of which occupy nearly one-half of the entire width of the river, the clear waterway being but 295 feet, whilst the total width of the piers is 244 feet. This structure is in a very dilapidated condition, and has lately shown numerous symptoms of its inefficiency as a means of communication between the King's County and Galway. It may however, be considered, (from its having been built in the reign of King John,) if not the oldest bridge over the Shannon, as at all events possessing an age which few other bridges can so satisfactorily trace, and is on that account, a very highly interesting work of antiquity. In its construction we find all that characterizes the early specimens of bridge architecture; the small arches for allowing the passage of the water, and, as before mentioned, unnecessarily wide piers, which have large angular projections not only to throw off the force of the current, but for the purpose of enabling passengers to retire into, to avoid carriages and horsemen when passing along its narrow roadway, the width between the parapets being only 12 feet.

The works of the foundation of the new bridge having been sufficiently advanced on the King's County side of the river, the first stone was laid by Colonel Jones, on Saturday, the 21st August; over which a brass plate was laid, bearing the following inscription:—

"SHANNON COMMISSION."

(Under the Act 2nd and 3rd Vic. Cap. 61.)

"By virtue of an Act passed in the second and third years of the reign of Her present Majesty Queen Victoria, the first entitled an Act for the improvement of the Navigation of the River Shannon, the following are the names of the Commissioners appointed for carrying the works into execution: Major-General Sir John Fox Burgoyne, R.E.K.C.B., K.T.S., &c. &c.; Lieut.-Colonel Harry David Jones, R.E., M.R.I.A., M. Inst. C.E.; Richard Griffith, Esq., C.E., F.R.S.E., M.R.I.A."

"This Bridge over the River Shannon at Banagher, was designed by Thomas Rhodes, Esq., C.E., M.R.I.A., M. Inst. C.E., the Commissioners' principal engineer, and the first stone laid on the 21st day of August, in the year of our Lord 1841.—Henry Buck, Esq., C.E., district engineer; Henry Renton, Esq., C.E. A. Inst. C.E., resident engineer; William Mackenzie, Esq., C.E., M. Inst. C.E., contractor.—Edward Hornsby, Secretary."

Having had an opportunity of inspecting the plans and other documents relative to the bridge, we are enabled to give some particulars which, perhaps, may be acceptable to our engineering readers. It is to consist of six semielliptical arches, of 60 feet span each, with a cast iron swivel bridge, of 45 feet span, to allow masted vessels and steamers an uninterrupted passage at all times. The following are the principal dimensions:—Span of stone arches each, 60 feet; rise of ditto, 16; thickness of abutment, 13; ditto of piers, 8; ditto of swivel bridge pier, 40; total length of bridge, including wings, 721; width of bridge, in clear of parapets, 24; ditto of carriageway, 16; ditto of each footpath, 4; thickness of arch stones at springing, 5; ditto crown, 2 feet 8 inches. The foundations will be all laid on a bed of strong gravel, at a level of about six feet below the bed of the river: the stone of which it is to be built is blue limestone, of a very fine quality, procured from a quarry recently opened adjacent to the works. The contract is stated to be about £23,000, and the whole of the works are expected to be completely finished in two years.

Mr. Fairvelle is the contractor for building the much required pier at Kilrush, which is to extend 150 feet into the sea in a westerly direction, and there are 120 men now daily employed in the immediate neighbourhood quarrying stones for the work. The masonry embankment forming on the northern shore close to the present pier is very forward, and will be a great improvement.

Mr. Vignolles, C.E., son of the celebrated engineer of that name, is appointed resident engineer to superintend the construction of the piers or quays at Kilrush and Cahircon.

Mr. Sykes, of York, is declared contractor for building the pier of Cahercon, under the Shannon Navigation Commissioners, and the preparatory works will be commenced immediately.

The new pier, or quay, at Kilteery, between Glin and Loughill, in progress under the Shannon Navigation Commissioners, will be completed against winter, and admit of sailing vessels and steamers coming to there, in 21 feet of water, while the new road from Abbeyfeale, through the interior of the country, will render this a work of great public benefit to the farmer and trader—hitherto deprived of a market for their produce.—*Limerick Chronicle.*

Railway in the Brazils.—A railway has received the sanction of the Brazilian legislature and the support of the government, which is to run from Rio Janeiro to communicate with the provinces of St. Paulo and Matto Grosso. It has only one chain of hills to cross, the Serra de Parahyba.

STEAM NAVIGATION.

The Cairo.—A new steamer bearing this title made her first appearance in the Thames on Friday, 17th ult., and excited general attention. She was built by Messrs. Ditchburn and Mare, of Blackwall, for the Peninsular and Oriental Steam Navigation Company, for the navigation of the Nile, and is intended as a branch steamer to convey passengers and luggage to and from various places on the banks of that river. The Cairo is a remarkably elegant vessel, similar in appearance to those very fast and pretty steamers called the Watermen, running between London and Woolwich, and built by the same firm. The Cairo, however, is four feet longer and flat bottomed, to adapt her for the shallow waters of the Nile, her draught being only two feet. She is propelled by two engines of 16 horse power each, from the factory of Messrs. Penn and Son, of Greenwich. The cylinders are oscillating, and the machinery, which occupies a very small space, is precisely similar to that in the Watermen, and of the same dimensions. The cabins, fore and aft, are tastefully fitted up with bed places and other conveniences for passengers. The Cairo is an iron vessel, and divided into five compartments with water-tight bulkheads separating each, which adds much to the safety of the vessel. The engines and machinery occupy such a small space that 100 persons can be accommodated in the cabins, and there are two spacious stow-rooms for luggage only, between the engine-room and the fore cabin, and the engine-room and after-cabin. The Cairo made a trial voyage from the Blackwall pier to Gravesend and back, and with all the disadvantages attendant upon the working of new engines and machinery, she passed every thing on the river, the Star, a large Gravesend steamer, only excepted, and fully came up to the expectations of the builder and engineer. Mr. Ditchburn and Mr. Penn, jun., who entertained a select party of gentlemen connected with steam navigation on board, have guaranteed the average speed of the Cairo at 15 miles an hour; but for the Nile, a light draught of water is her greatest recommendation. Several other iron steamers, of similar dimensions, are to follow the Cairo to the Nile, and her design and appearance has been so much approved of, that the Watermen's Steam Packet Company intend to augment their fleet by five new vessels of the same size and machinery of the same power, to be in readiness by Easter Monday next. Messrs. Ditchburn and Messrs. Penn have taken the contracts.—*Times.*

Marine Engines.—It may be said that Great Britain is the manufactory for the whole world for marine engines; at one factory alone (Messrs. Maudslay and Field), there are at the present moment going through their various stages of manufacture, engines of 3600 horse power in the gross, viz. the *Devastation*, a government steamer with 400 horse power, fitted with double cylinders, now in the Woolwich basin just ready for action. The *Thames* and *Medway*, each with 400 horse power beam engines belonging to the West India Mail Company; the *Thames* is nearly ready; the *Herculana* (sister boat to the Mongebello) with 200 horse power, double cylinders, nearly completed for the Neapolitan government; and the *Memnon* with 400 horse power double cylinders for the East India Company. All the above engines are now being fitted on board of the several vessels—besides the above, in the same factory there are now in progress four pair of 150 horse, one pair of 100 horse for the Danish Government, and a pair of 100 horse for the admiralty all with double cylinders, also two pair of 50 *annular* cylinder engines on Mr. Joseph Maudslay's last patent. In another place we have noticed engines for Egypt and the United States.

The Satellite.—A beautiful iron vessel built by Messrs. Ditchburn and Mair has been running the last two months between the Adelphi and Gravesend with great speed and regularity. She draws but little water, and frequently steams the distance from Blackwall and Gravesend in about an hour; she has a pair of 35 horse *steeple* engines arranged expressly for her, which are a beautiful specimen of Messrs. Miller, Ravenhill and Co.'s. workmanship, they occupy a very small space in the vessel and are fitted with expansive gear worked with great simplicity.

Steam Towing.—We learn that during the present fruit season a steamer will tow vessels between Malaga and Gibraltar. It is to be hoped that this system of towing in the sea will be extended.

The Chili.—We regret to learn that this steamer has been wrecked on the coast of the same name.

FOREIGN INTELLIGENCE.

The Mosaic Pavement at Salzburg.—*Munich, Sept.* 7.—Private accounts from Salzburg state that it is intended to remove the lately discovered Roman mosaics from their present position, and lay them down in another situation, where they may be protected from the influence of the weather. It is said that the place fixed on is the site of Mozart's monument. Besides the large mosaic pavement, the design of which consists only of architectural ornaments and foliage, two smaller pieces were discovered, which are equally devoid of pictorial representation. There are likewise considerable remains of the walls of the chamber to which these mosaics belonged. The paintings on these are similar to those found at Pompeii, consisting of flowers and tendrils of vines on a red ground. The mosaics, as well as the paintings, are evidently of the third or fourth century after Christ. One very striking peculiarity in the smaller mosaics is the frequent introduction of the sign of the cross, which it is scarcely possible to regard as a mere accidental ornament. At the depth of half a foot below the large mosaic pavement, is another of finer workmanship, which, as it is necessarily the more ancient, promises to be an object of still greater interest. The proprietor of the house must have had some motive in thus covering over the old pavement and raising the floor. If once the upper pavement were removed, there would be no great difficulty in uncovering the second.—*Allgemeine Zeitung.*

St. Petersburg, August 26.—300 workmen are now daily employed in rebuilding the Imperial palace in the Kremlin at Moscow, which was pulled down four years ago. The new building is made fire-proof, the very rafters being of iron, and no wood being employed except for the floors. This palace is to be heated by means of 250 metal pipes communicating with every part of the building, and proceeding from a furnace contained in the vaults below. The ornamental gilding alone costs 300,000 rubles.

The great hall of St. George of the winter palace, which had just been rebuilt, had given way, and all the splendid Italian paintings and vases which it contained been destroyed.—The loss is estimated at several millions of francs. No life was lost; and the remainder of the palace was intact. On the day before the accident a chapter of the Order of St. George was held in the hall which has fallen.

Venice.—A bridge is about to be constructed at Venice, intended to unite that city to the Continent, and to connect it with the railroad of Milan. The management of this gigantic undertaking has been conceded to the engineer, Antoine Busetto Pitich; the average expense is estimated at 4,830,000 livres Austrian. The bridge will also contain an aqueduct intended to supply the town with fresh water, which has hitherto been supplied in boats from the Continent; Venice being unprovided with wells and fountains, and having but very few cisterns.

The Improvement of the Seine.—A commission has been appointed by the Prefect of the Seine, to take into consideration a project for improving the navigation of the river within and below Paris. Part of the project consists in establishing this navigation on the left branch, running along one side of the Cité. Another plan attached to it is the construction on the centre of the Pont Neuf of a vast building, from which eight turbines, of the force of 4000 horse power,(?) would throw immense quantities of water into every quarter of Paris.

Russia.—A joint-stock company in England has obtained the Emperor's permission to make an iron railway from Moscow to St. Petersburgh, and will begin its operations perhaps this autumn, but certainly in the spring. Five years are allowed to complete the whole line, which will be 33 miles longer than the common road between Moscow and St. Petersburgh, because it is to pass through to Bybinsk, in the government of Yaroslaw, on the right bank of the Volga, because that town carries on the most extensive corn trade with St. Petersburgh. All the vessels laden with the produce of the south, which comes up the Volga to the north, must stop here.—*Hamburgh papers, Sept.* 10.

The Rhein and Mosel Zeitung of Sept. 4 states, that in the course of the operations in the Cathedral of Cologne for the restoration of the pictures of the Saviour and the Apostles Peter and John, the workmen have brought to light several colossal figures which have been obliterated with whitewash during the last century. It is to be hoped that these figures will be restored along with the others to their original state. The same journal mentions that the two pictures which had been wantonly injured at the exhibition in Cologne have been again hung up in their places, after having been removed for the purpose of repairing them. In spite of every inquiry, the person who committed the malicious act has not yet been discovered, nor is it possible to assign any imaginable ground for so wanton an outrage.

MISCELLANEA.

The Sun Fire-office Building.—The dispute between the city authorities and the Sun Fire-office, is at last terminated by the consent of the latter body to set back their building to the act of Parliament line, and to round the corner at the south-east of Bartholomew-lane. The Commissioners of Sewers will pay, as the value of the land thus appropriated to the public, such a sum as may be determined upon by Mr. Cockerell, the surveyor of the Sun Fire-office, and some surveyor to be appointed by themselves. The directors of the Sun Fire-office have, in the opinion of the citizens, acted most unwillingly and ungraciously, and it would have been much more creditable to these directors to have conceded to general convenience, what was never equitably theirs, than, by persisting in forming this projection, to have compelled the Commissioners of Sewers to appropriate public monies to an improvement in which the Sun Fire-office was really as much interested as the public themselves.—*Times*.

New Mode of Rating the Gas and Water Companies.—Some of the parishes in the eastern districts of the metropolis have lately been making a valuation survey of the length and bores of the various mains and branch services belonging to the Water Companies in their respective parishes, as also the length of the gas-pipes laid down, and all property belonging to them, for the purpose of rating them on a fair and equitable per centage, in the place of allowing the companies to compound for them, by the payment of a stipulated annual sum as heretofore, and which composition has been found in reality to be much beneath their actual value. The companies' profits, it is well known, being very considerable, their property has not been rated in a fair proportion to the general property of the parish. By the adoption of rating the companies after the survey, the parishes will derive a great annual increase of revenue, which will contribute much to relieve the parishioners in general, by adding to the parochial resources. The example is about to be followed by other parishes in the southern districts, who are making surveys for the same purpose, where the source of revenue, increased by rating, will be much more considerable, in consequence of the immense quantity of water and gas-pipes laid down in the southern districts by several companies in rivalry of each other.—*Times*.

Improved Locomotive.—Messrs. Coulthard, of Gateshead, engineers, have just completed a powerful locomotive engine, including all the modern improvements, with also, in one respect, a novelty in construction of great practical advantage. This consists in the rejection of what we may call the "cinder-chamber," so that the bars are exposed to the external atmosphere, and the ashes fall directly upon the ground. Thus, the bars being presented to the cold air on the outside, they do not waste away with that rapidity which is consequent upon the ordinary construction, and considerable economy is the result. The engine being built more for power than for speed, the works are placed chiefly on the outside, and are of peculiarly easy access for purposes of repair. Trial was made of her powers on Thursday week, in the presence of Mr Wood, under whose superintendence she was built, and other gentlemen, who were much gratified by her performances; and after remaining for experiment on the Brandling Junction Railway a few days from this time, she will be removed to the Clarence line, to commence her labours in good earnest.—*Tyne Mercury*.

The Strike at the New Houses of Parliament.—The strike of the two hundred masons is likely to be productive of much injury to the working men, as they could not have chosen a worse plea on which to strike, while they have put themselves in direct contact with government. All combinations are bad, and particularly where they are employed to repress industry for the benefit of idleness. Nothing can be more infamous than a system which fines men for working faster than their fellows. The masters will gain by this imprudence.

Sir William Burnett's patent process for the preservation of timber, canvass &c. is gaining ground with the public; it has already been adopted by the government authorities at the dock yards. For the service of the Portsmouth Dock Yard, there is now being made at Messrs. Fairbairn's, Mill Wall, a large iron tank, 51 feet long and 6 feet diameter, with air and force pumps for the purpose of impregnating timber and canvass with Sir William's solution—it is also to be applied for the preservation of upwards of 6000 yards of felt, and the deal casing to be used for clothing the steam boilers of H. M. War steamer the *Growler*, now having her engines put on board at Messrs. Seawards manufactory at Limehouse.

Hoax by a Bank Clerk.—Last month we transferred into our columns an extract from the *Literary Gazette*, giving a short account of a newly-discovered method of propulsion, by which a common garden or invalid chair could be propelled along a common road by a galvanic power at the rate of 40 miles an hour; and it was further stated that the young man who had discovered this new power daily travelled in his chair from St. Alban's to the Bank of England in half an hour—a distance of 22 miles! Great curiosity was naturally excited by the supposed discovery, and the young man, who is a Bank clerk, was questioned concerning it, both by the governor of the Bank, and also by Mr. Smee, the cashier, &c. He was invited by the latter, and by several other persons, to display the powers of his new machine, but made repeated excuses for delay; he first excused himself on the score of illness, and on being again pressed to exhibit the machine, he stated that he had driven it accidentally against a post, and shattered it to pieces. Upon being, however, more closely questioned, he at last confessed that the whole story was a hoax, and that no such machine had ever existed, save in the fertile imagination of the supposed inventor. This *denouement* was only made known on Thursday, and it has created a great sensation in the Bank of England. The motive of the youth for the above hoax cannot be accounted for. We are informed, however, that some such galvanic power does exist,(?) but that the expense is too great to allow of its being made use of.—*Times, Aug.* 28.

Projected Light on the Goodwin Sands.—The Lords of the Admiralty and the Board of the Trinity-house have finally arranged with Mr. W. Bush, the engineer, that the cast-iron caisson, which he has now nearly completed at Deal, shall on Wednesday, the 15th inst., be floated to its place on the north-east end of the Goodwin Sands. It will be remembered some weeks ago we noticed the progress of this undertaking, which is now about to be sunk and firmly fixed to the chalk rock which Mr. Bush calculates on finding about 30 feet below the surface of the sand. The caisson will then form a base upon which a lofty column of stone will be raised, surmounted with a light, and that from its position and general usefulness to all maritime counties, it will be called "The Light of all Nations," which will be inscribed on the column. This new Goodwin light is not only designed as a beacon to warn the mariner off these sands, which have been so fatal, but is also intended as a guide from the North Sea, through a swashway, hitherto, from its danger, impracticable. This channel is about half a mile wide, and leads into a capacious bay within the Goodwin, having from 30 to 40 feet water, and being sheltered from every quarter, ships will there ride in safety. A very large party are going out on the 15th to view the floating of the caisson, and the Government steamers are ordered to be in readiness. It is expected that his Grace the Duke of Wellington, who takes a lively interest in the undertaking, will be present on the occasion.—*Times, Sep.* 6.

Newly Recovered Land.—Since the opening of the new cut from Eau Brink to Lynn, which took place about 20 years ago, the old channel, which was very wide and spacious, by which the water of the Ouse and its tributary streams were formerly conveyed to Lynn, has been gradually silting up, and much of it has now become firm land, producing rich and flourishing herbage. A few days since a portion of this newly recovered land (containing about 900 acres), which is now embanked and fenced with live quickset fences, and divided into convenient pieces for occupation, was let by auction, at the Globe Inn, Lynn, and the annual rental obtained for it averages nearly 3*l.* per acre. Calculating upon this ratio, were an embankment of the Wash to take place, the annual value of the land which would be obtained by that undertaking we might reasonably estimate at not less than £500,000. At the last quarterly meeting of the Lynn town-council, Mr. F. Lane laid upon the table a copy of a memorial presented to the Commissioners of Woods and Forests, which memorial referred to the inclosure of the Great Level of the Wash, and was accompanied with a letter, stating that the application to Parliament upon that subject was intended to be renewed in the next session. —*Norfolk Times*.

London Bridge.—This bridge is to be closed for the purpose of repaving the road, which is to be done with Aberdeen Granite, not exceeding three inches in width, to be laid in parallel courses.

Windsor Home Park.—Great improvements are going on by order of Her Majesty. A very neat iron bridge has been erected over the Datchet road which has been covered with the Seyssel Asphalte. Other works in Asphalte have also been executed at the castle.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 24TH AUGUST, TO 23RD SEPTEMBER, 1841.

Six Months allowed for Enrolment.

RICHARD WHITAKER, of Cambridge, machinist, for "*improvements in cutting the edges of books, and paper for other purposes; and in impressing ornaments, letters, and figures on the binding of books and on other surfaces.*"—Sealed September 4.

THEOPHILE ANTOINE WILLHELME COUNT OF HOMPESCH, of Mivart's Hotel, Brook-street, Middlesex, for "*improvements in obtaining oils and other products from bituminous matters, and in purifying or rectifying oils obtained from such matters.*"—September 4.

JOHN BOOT, of Quandron, Leicester, lace glove manufacturer, and JOHN KING, of Henor, lace-maker, for "*certain improvements in machinery or apparatus for manufacturing or producing figured or ornamented fabrics in ivory and bobbin-net lace machines.*"—September 4.

JOHN GRAFTON, of Cambridge, civil engineer, for "*an improved method of manufacturing gas.*"—September 4; two months.

MICHAEL COUPLAND, of Pond-yard, Southwark, millwright and engineer, for "*improvements in furnaces.*"—September 4.

GEORGE WILDES, of Coleman-street, merchant, for "*improvements in the manufacture of white lead.*" (Being a communication.)—September 4.

WILLIAM HILL DARKER, senior, and WILLIAM HILL DARKER, junior, both of Lambeth, engineers, and WILLIAM WOOD, of Wilton, carpet manufacturer, for "*certain improvements in looms for weaving.*"—September 4.

LOUIS LACHENAL, of Titchfield-street, Soho, mechanic, and ANTOINE VIEYRES, of No. 40, Pall-mall, watch-maker, for "*improvements in machinery for cutting cork.*"—September 4.

JOHN JUKES, of Lewisham, gentleman, for "*improvements in furnaces or fire-places.*"—September 6.

PIERRE PELLETAN, of St. Paul's Church-yard, professor of medicine, for "*improvements in propelling fluids and vessels.*"—September 6.

JOSEPH DREW, the younger, of Saint Peter's Port, for "*an improved method of cutting and rolling lozenges, and also of cutting gun-wads, wafers, and all other similar substances, by means of a certain machine designed by him, and constructed by divers metals and woods.*"—September 6.

LUKE HEBERT, of No. 12, Staple's-inn, London, for "*certain improvements in apparatus and metals used in the manufacture of gas for illumination: also improvements in the apparatus for burning the same.*" (Being a communication.)—September 8.

RICHARD ELSE, of Gray's-inn, Esq., for "*certain improvements in machinery or apparatus for forcing and raising water and other fluids.*"—September 8.

WILLIAM FAIRBAIRN, of Millwall, Poplar, engineer, for "*certain improvements in the construction and arrangement of steam engines.*"—September 8.

JOSEPH COOKE GRANT, of Stamford, ironmonger and agricultural implement maker, for "*improvements in horse rakes and hoes.*"—September 8.

NATHANIEL CARD, of Manchester, candle-wick-maker, for "*certain improvements in the manufacture of wicks for candles, lamps, or other similar purposes, and in the apparatus connected therewith.*"—September 8.

JAMES THORBURN, of Manchester, machinist, for "*certain improvements in machinery for producing knitted fabrics.*"—September 8.

MILES BERRY, of Chancery-lane, civil engineer, for "*a new or improved method or means of, and apparatus for, cleansing typographical characters or forms of type, after being used in printing.*" (Being a communication.)—September 8.

OGLETHORPE WAKELIN BARRATT, of Birmingham, metal-gilder, for "*certain improvements in the precipitation or deposition of metals.*"—September 8.

JOSEPH GARNETT, of Haslingden, dyer, and JOHN MASON, of Rochdale, machine maker, for "*certain improvements in machinery or apparatus employed in the manufacture of yarns and cloth, and are also in possession of certain improvements applicable to the same.*" (Being partly a communication.)—September 8.

EDWARD LOOS DE SCHELESTADT, engineer and chemist, and ETIENNE STERLINGNE, tanner, of Regent's-square, in the county of Middlesex, for "*certain new or improved machinery or apparatus and process for tanning skins or hides, and preparing or operating upon vegetable and other substances.*"—September 8.

GEORGE MANNERING, of Dover, plumber, and HENRY HARRISON, of Ashford, plumber, for "*certain improvements in the means of raising water and other liquids.*"—September 8.

ALPHONSE RENE LE MIRE DE NORMANDY, of Redcross-square, Cripplegate, doctor of medicine, for "*certain improvements in the manufacture of soap.*"—September 8.

WILLIAM CROSSKILL, of Beverley, iron-founder and engineer, for "*improvements in machinery for rolling and crushing land, and in machinery to be used in the culture of land.*"—September 9.

WILLIAM HICKLING BENNETT, of Ravensbourne Wood-mills, Deptford, gentleman, for "*improvements in machinery for cutting wood, and in apparatus connected therewith, part of which may be applied to other purposes.*"—September 9.

CHARLES LOUIS STANISLAS BARON HEURTELOUP, of Albany-street, Regent's-park, for "*an improved manufacture of continuous priming for, and improved mechanism for the application of the same to, certain descriptions of fire-arms.*"—September 9.

CONRAD FREDERICK STOLTMEYER, of Golden-terrace, Barnsbury-road, Islington, merchant, for "*certain improvements in obtaining and applying motive power by means of winds and waves, for propelling vessels on water, and driving other machinery.*"—September 17.

WILLIAM NEWTON, of Chancery-lane, civil engineer, for "*improved machinery for manufacturing felts or felted cloths.*"—September 20.

JOSEPH HULME, of Manchester, engineer, for "*certain improvements in machinery or apparatus for grinding, sharpening, or setting the teeth of cards, or other similar apparatus employed for carding or operating upon cotton, wool, or other fibrous substances.*"—September 20.

THOMAS HUCKVALE, of Over Norton, Oxford, farmer, for "*improvements in horse-hoes, and in apparatus for treating and dressing turnips, to preserve them from insects, and promote their growth.*"—September 20.

ALFRED ELAM, of Huddersfield, surgical instrument maker, for "*improvements in apparatus for instruments for the relief and cure of procedencia and prolapsus uteri.*"—September 20.

LUKE HEBERT, of Birmingham, for "*improvements in machinery for fulling woollen cloth.*" (Being a communication.)—September 20.

WILLIAM CHARLTON FORSTER, of Bartholomew Close, gentleman, for "*a material, or compound of material, not hitherto so used for preventing damp rising in walls, and for freeing walls from damp, which material, or compound of material, can be applied to other purposes.*"—September 20.

FRANCOIS MARIE AG. THE DEZ MAUREL, of Newington Terrace, Surrey, for "*an improved buckle.*" (Being a communication.)—September 20.

GEORGE SHILLBEER, of Milton-street, Euston-square, carriage builder, for "*improvements in the construction of hearses, mourning and other carriages.*"—September 20.

WILLIAM BUSH, of Deptford, engineer, for "*improvements in the means of, and in the apparatus for, building and working under water.*"—September 21.

COMTE MELANO DE CALCINA, of Nassau-street, Soho, for "*improvements in paving or covering roads, and other ways, or surfaces.*"—September 21.

EDWARD EMANUEL PERKINS, of Weston Hill, Norwood, gentleman, for "*improvements in the manufacture of soap.*"—September 21.

JOHN DUNCAN, of Great George-street, Westminster, gentleman, for "*improvements in machinery for driving piles.*"—September 21.

HENRY BESSEMER, of Baxted House, Saint Pancras, engineer, and CHARLES LOUIS SCHONBERG, of Sidmouth Place, Gray's Inn Lane Road, artist, for "*improvements in the manufacture of certain glass.*"—September 23.

GEORGE SCOTT, of Louth, miller, for "*certain improvements in flour mills.*"—September 23.

JAMES WHITELAW, engineer, of Glasgow, and JAMES STIRRATT, manufacturer, of Paisley, Renfrew, for "*improvements in rotary machines to be worked by water.*"—September 23.

TO CORRESPONDENTS.

Mr. Pilbrow.—*We shall be happy to lay before our readers any new facts he may bring forward in support of his peculiar form of Engine, and when he has got the steam up in the 50 horse engine now constructing on his principle, we shall feel much pleasure in recording the results.*

Mr. Barret and Mr. Brooks.—*We have been again called to account by these two gentlemen, for not publishing their communications; we can assure them that it is our desire to accommodate all our correspondents if possible, but on account of the numerous articles connected with the profession which demand immediate attention, we are obliged to defer controversial articles; we will however endeavour next month to accommodate both Mr. Barret and Mr. Brooks.*

Probably after three years more practice F. will say that we have been merciful.

Books received which must stand over for notice until next month—Elements of Perspective Drawing; Report on Boucherie's Process of Preserving Wood; Denton's Outline of a Method of Model Mapping; A Letter to the Shareholders of the Bristol and Exeter Railway, by W. Gravatt, C.E., F.R.S.; this letter discloses some suspicious circumstances, which we hope before our next publication appears, the parties concerned will be able to clear up.

We regret that we have not been able to find room for a very valuable report on the Improvement of Lough Erne, by Mr. Rhodes, E.C.

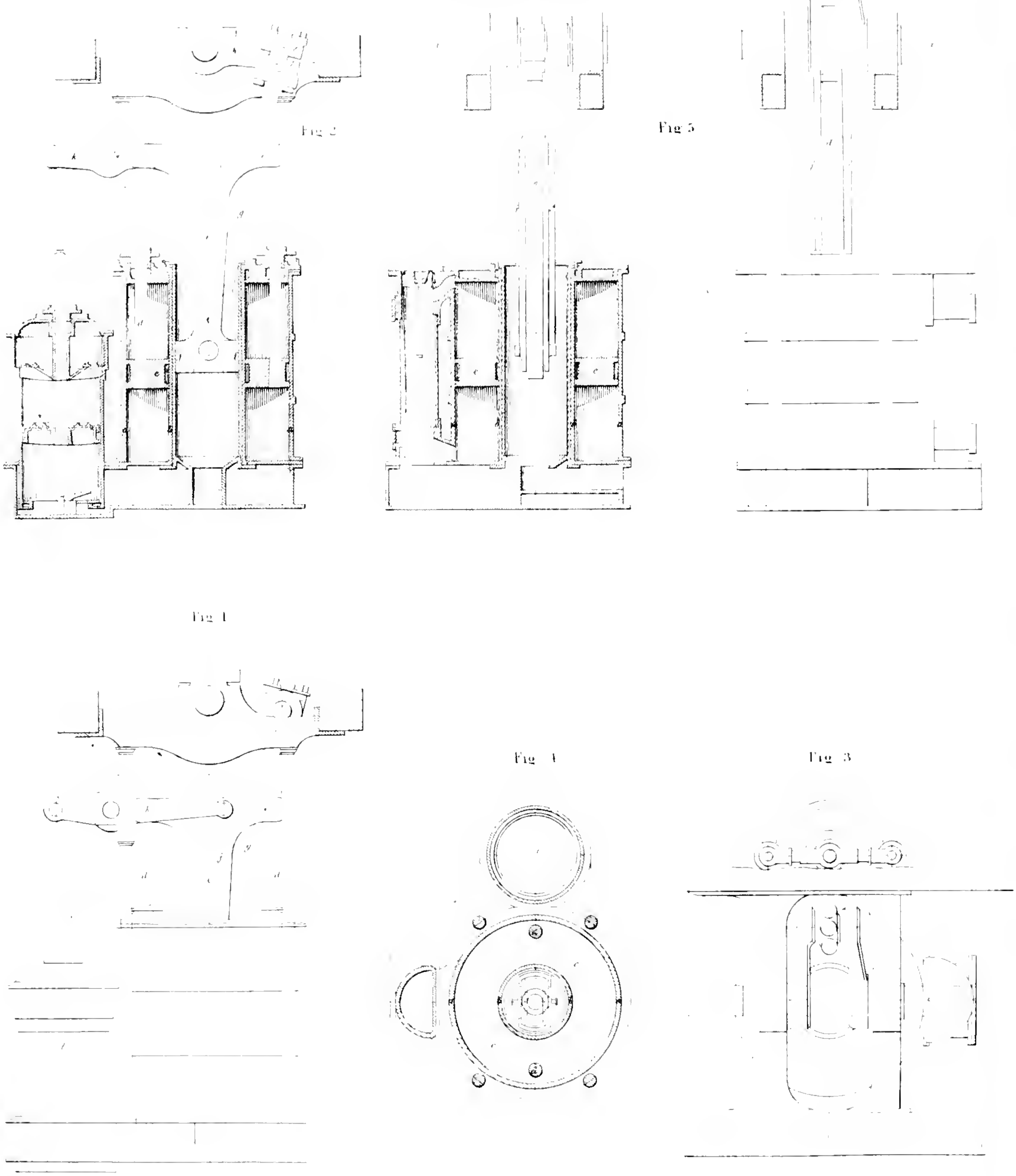
Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

Joseph Maudslay's Improved Marine Steam Engine

Patd. [illegible]



IMPROVEMENTS IN THE CONSTRUCTION OF MARINE STEAM ENGINES.

(With an Engraving, Plate VIII.)

Abstract of Specification of a Patent granted 16th March, 1841, to Joseph Maudslay, of the firm of Maudslay, Sons, and Field, Engineers, Lambeth.

These improvements relate to the arrangement of certain parts of steam engines of that kind, (usually termed direct action engines), whereof the centre of the cylinder is situated immediately beneath the axis of the cranks, and are assigned for the purpose of producing and applying a greater amount of steam power than has heretofore been available within a given space or area on ship board, and for the purpose of applying a greater length of stroke and connecting rod in a given height, than can be obtained (in a direct action engine) by any other means, and the lower end of the connecting rod guided without any lateral pressure on the piston or piston rods.

They consist in disposing the connecting rod in a space which is left vacant for its reception, (together with the requisite appurtenances of that rod) within the central part of the steam cylinder, and within the central part of the piston which works up and down in the said cylinder, the steam cylinder having for that purpose a small cylinder fixed concentrically within it, and the piston being a broad ring or annulus, which encompasses the said small cylinder, and fits into the annular cylindrical space which is left between the interior of the steam cylinder, and the exterior of the said small cylinder. The annular piston is moved alternately up and down in the said annular cylindrical space, by the force of steam acting therein, but which steam does not enter into the interior of the small cylinder, neither is any piston or part of the piston fitted therein, but the interior of the small cylinder is left open at top and vacant within, for the connecting rod and its requisite appurtenances to work in, with liberty for that rod to move up and down therein, and likewise with liberty when so moving, to incline as much as it requires to do, from a vertical position alternately on one side of the vertical and then on the contrary side thereof, in consequence of the upper end of the connecting rod accompanying the motion of the crank pin in its circular orbit (in the usual manner of connecting rods), whilst the lower end of the said rod moves alternately up and down in a vertical line, that line being at the central line or imaginary axis of the steam cylinder, and which axis would in ordinary steam engines be situated in the centre of the solid metal of the ordinary piston and piston rod, but according to my improvements in the arrangement and combination of the various parts, the said vertical line or imaginary axis of the steam cylinder, is situated in an open space which, as already stated, is left vacant for the purpose of receiving the connecting rod, together with its appurtenances within the central part of the steam cylinder, and within the central part of the annular piston, in consequence of the small cylinder being fixed concentrically within the interior of the steam cylinder, and in consequence of the cylinder cover, as well as the piston being each a broad ring or annulus, and each being suitably fitted to the annular cylindrical space between the two cylinders, but without covering or occupying the interior of the small cylinder.

These improvements will be more fully understood by a reference to the accompanying engraving, and the following description thereof, in which fig. 1 is an elevation of the said engine taken longitudinally, fig. 2 is a longitudinal vertical section corresponding to the side elevation fig. 1, fig. 3 is a horizontal plan of the upper part of the engine, and fig. 4 is a horizontal section of the cylinder thereof; fig. 5 is a transverse vertical elevation and section representing two such engines disposed side by side for combined action; one of the two engines in fig. 5 being represented in elevation, the other in section. The same letters of reference denote the same parts in all the figures.

The exterior or large cylinder is shown at *a a*, the interior and smaller cylinder concentric to it at *b b*, and an annular piston at *c c*, having two piston rods *d d*, working through stuffing boxes in the annular cover of the cylinders, the upper ends of which rods are affixed by keys to the T shaped cross head *e, e, e, e*, at the lower ends of which cross head there is a slider *f*, working within the inner cylinder, to this slider *f* one end of a connecting rod *g* is attached, the other end of the rod being attached to the crank pin of the crank *h*, on the propelling shaft.

From this arrangement it will be perceived that by the ascent and descent of the piston *c c*, the rods *d d*, will cause the cross head *e e*, to move perpendicularly up and down, and in so doing to raise and depress the slider *f*, with the connecting rod *g*, which rod will by that means be made to give rotary motion to the crank *h*, and thereby cause the paddle-wheel shaft *i* to revolve. The rods *j j*, connected to the slider *f*, will at the same time work the levers or beams *k k*, to which the rods of the air pump *l*, are attached.

Having fully described the invention, the patentee desires it to be understood that he does not claim the use of two concentric cylinders and an annular piston, but he claims as his invention the use of the space within the interior cylinder for the lower end of the connecting rod to work in, whereby the ultimate length of stroke and connecting rod within a given height is obtained, and the lower end of the connecting rod guided without any lateral pressure on the piston or piston rods.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXII.

> " I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. ONE of the prettiest little bits of street architecture about town that I know of is the front of a small house adjoining the Polytechnic Institute, in the upper part of Regent Street;—a very clever and artist like specimen of Italian, in which rustication of a more than usually finished and picturesque character has been very happily applied—of that kind which may be termed *mixed* rustication, both vermiculated rustics and moulded ones with plain faces being employed, —as has likewise been done in the new houses on the south side of Lowndes Square. The character thus produced is at once rich and sober. The archway forming the entrance to some livery stables, on one side, is not the least agreeable feature in the design, nor is it any compliment to it to say, that it is in infinitely better taste than the huge slice of architectural gingerbread which Nash clapped by way of frontispiece, against that mass of ugliness the Royal Mews at Pimlico. How that Nash did palm his Brummagem stuff upon old George the Fourth!—and took pretty good care to be paid for it in sterling cash —good and lawful money of the realm!

II. Because it does not happen to be as big, as tawdry, and as ugly as one of the Regent's Park Barracks—those genteel Union Workhouse affairs—no one has been able to discern any merit at all in the specimen above referred to. The Paddington or Paddy style—the horrible mushroom monstrosities which are now springing up in that district, and which are apparently directed by some Nash the second—some genius well qualified to be the successor of that mighty master, —are far more to John Bull's taste, and according to his notion of "genteel houses."

III. "Can you give me any sure general rule for my guidance by adhering to which I shall always be certain of attaining superior beauty in composition and design?"—Such was the question once put by an architect to a connoisseur of acknowledged taste, who thereupon replied: "My advice was asked the other day by a writer who wished me to inform him what rule he should attend to in order to raise himself in the literary world. My counsel to him was: be original if you can, be interesting if you are able. As I answered him, so now I answer you: display both invention and taste, and into whatever you do take care to put character and effect. I know of no other general rule; but if you can act up to that, I believe you will find it a sufficiently efficacious one." A plain answer to a very *simple* question!

IV. It is a wonder that Pugin has not shown up the range of Brummagem Gothic buildings in the Temple,—most trumpery and tasteless as to character, though, no doubt, not very trumpery—perhaps of most sterling merit, as to cost. Not a little strange, too, is it that he did not have a fling at that notable example of Civic Gothic the façade of Guildhall, which is such a perfect monstrosity that it deserves to be pulled down.

V. Besides giving Turner a tremendously heavy blow—one almost sufficient to demolish him, and put him quite *hors de combat*, the reviewer of the "Exhibitions," in Blackwood, deals a few home strokes at Stanfield, and also at our present English view-mania. "What," he asks, "must the inhabitants of all the tumbledown places on the Rhine and the Rhone think of us, our scenery, our buildings, and our taste, when they learn that representations of their beggarly edifices and their abominable outskirts form the chief ornaments of our Royal Exhibition?"—"Nor in respect to architecture," he afterwards observes, "are our views always in good taste. The low and the mean, the decayed and the poverty-stricken, are often thought to be the only picturesque, as if *picture* must indulge in vile associations. Let not art take *habitat* in "rotten rows," nor vainly imagine that the eye should seek delight where the foot would not willingly tread—the purlieus of misery and vice. All the pictorial charms of light and shade, and colour are to be found in subjects which shall not degrade them. There is no lack of architecture that elevates instead of depressing the mind, both by its grandeur of design, the work of genius, and by the associations it calls up. In a word, in every branch of art let what is low and mean be discarded, however it may tempt the artist under the idea of the picturesque."—To the above advice which is very much needed, might be added another wholesome caution namely, that in subjects more or less professedly architectural, the architecture itself should be treated as principal—as that in which the main interest lies, and not as too frequently happens, exhibited little more than nominally being nearly slurred over, while the value of the composition is made to depend upon accessories and casual circumstances—perhaps on *staffage* and figures, or some exaggerated contrast of light and shade, improbable if not impossible,—a pyebald medley of midday and midnight. As to architectural character, whether arising from the ensemble or the detail, that is not to be looked for in the "illustrations" annually manufactured to suit the taste of the million. We have views of Windsor Castle, wherein the building itself shows itself only as a mere speck in the landscape, the real view being that of trees and cattle, or figures in the foreground. In many cases, indeed, such mode of representing and "illustrating" buildings is not only highly convenient, but suitable and advantageous also, the things themselves being of no interest, or at all worth being shown. This may be affirmed of almost the greater part of topographical illustrations—views of the most insipid and common place houses, &c. imaginable, "of no value except to their owners."

VI. One might almost imagine that scarcely a building of any note had been erected in Germany within the last five and twenty years,—that Berlin, Potsdam, Munich, Dresden, Vienna, Hamburgh, &c. could not boast of a single new architectural feature of any merit, that Schinkel, Klenze, Gartner, Moller, Gutensohn, Ohlmuller, Semper, &c. had executed nothing—nothing at least deserving the attention of the English public. How else are we to explain the neglect which modern German architecture has experienced from those who set themselves up as luminaries of taste, to enlighten the public, and to "illustrate" by their pencils the *notabilia* of other countries?—Our consolation must be that perhaps we lose very little by such subjects as those above alluded to being passed by unnoticed by our manufacturers of views and "illustrations,"—things for the most part made up from slovenly, hurried sketches, which the engraver is left to make out as well as he can, and to dress up to the best of his ability. What such productions want in regard to truth and fidelity, is amply made up for by imagination and invention,—which have ever been reckoned among the more valuable qualities of art. Besides which there is one very great advantage attending the disregard of truth-telling accuracy, which is, that it does not forestal the gratification to be derived from viewing the buildings and places themselves, since they are generally found to be altogether different from their pretended representations. Thus when seen they make all the impression of perfect novelty, and produce double surprise—agreeable surprise at finding them greatly surpass expectation, and a queerish, indiscribable sort of surprise at finding out how much we have been all along *mist*-ified by owlish illustrators.

VII. After seeing to-day the works at the New Houses of Parliament I feel most amiably disposed towards Mrs. Wright of "awful conflagration" celebrity—whom I once, I believe, called a stupid old Jessabel worthy of the pillory, for had she by timely interference prevented the "accident," the splendid pile now rising to view would never have been reared. It was a mercy that the old "Houses" were burnt down when they were; since had the fire occurred during the "reign" of James—that is, the reign of James Wyatt "of execrable memory,"—we should have had some strange Gothicizings, such as those which now strike us with astonishment in some of the buildings still remaining in what was formerly the river front. The great fault of Mr. Barry's Gothic is that it puts us quite out of conceit with a good many other things, and with Windsor Castle among the rest; which I must confess falls greatly short of what I had been previously led to expect, there being very much in it that is exceedingly questionable as to taste. Not the least remarkable circumstance in Barry's edifices is that the inner courts—the quadrangle of the Speaker's residence, for instance, will be though less elaborate as carefully designed and finished as those parts which are exposed to public view; whereas the greater part of the exterior of the British Museum presents only a mass of plain brick wall, with naked windows. I admit that more attention is paid to design in the inner court of that edifice,—and wonderfully frigid it is—classically dull and Smirkish throughout. Poor Smirke! how greatly he is to be pitied!—and for the very reason that many may now envy him, to wit, because he has had so many opportunities of manifesting his imbecillity. Barry—Smirke, they are as far asunder as the two poles; or I might say the difference between them is that of the tropical and the frozen regions. As to Barry, I am afraid that his Houses of Parliament will sadly discomfort Welby Pugin, by giving the lie direct to his assertions

VIII. "One of the Ventilation Folks" has taken too much *au pied de la lettre*, the obviously quizzical remarks in which I indulged in regard to the excessive and *fussy* rout on the subject of ventilation, as if it was a perfectly new discovery, and as if people had been suffocating themselves for ages past, rich and poor alike, in palaces as well as in hovels, in the country as well as in towns, and inhaling pestilence at every breath, at least when within doors. Nothing as far as I can discover, did I say in favour of stinking alleys, and frowsy rooms; nor did I express any admiration for the *aroma* of a drain, though from what the "One" has said it might almost be fancied that I recommended it as "a cheap and elegant substitute" for attar of roses. My remarks went no further than a little banter on the overstrained necessity for far greater attention to ventilation than has hitherto been considered requisite, except for prisons, factories, and other buildings where people are densely pent up together. That the doctrine of the Ventilation Folks is somewhat overstrained can hardly, I think, be denied: for the plain reason that it proves rather too much, and that a great portion of the population in towns could hardly exist at all; nevertheless exist they do, and that, too, under circumstances which must frequently aggravate a thousandfold the mischiefs arising from insufficient ventilation.

If ventilation be of such exceeding importance as is insisted upon by its advocates, how terribly—nay fatally must those people blunder who take their daily airing in a carriage with the windows drawn up, and which is then nearly air-tight. Not less blundering is the practice of those who make it a point to secure an airy bedchamber, and then closet themselves within curtains drawn so closely around them, that they might as well sleep in a closet of the same dimensions as their bed. If "Ventilation" be quite in the right, Gentility must be confoundedly in the wrong; since what barbarians those must be who in order to gratify a little trumpery vanity, stow away and squeeze their "five hundred dear friends" together, till they might nearly as well be in the Black Hole at Calcutta! Why do not the Ventilation Folks call upon the legislature to make all such "At Homes" illegal assemblages, devised for the purpose of smothering her Majesty's loyal and fashionable subjects? I know not whether the Ventilation Folks are particularly musical, but if they are so at all, I presume that their chief and favourite instrument is the Æolian harp; at the same time I suspect that some of them have no particular dislike to playing the *trumpet*.

HINTS ON ARCHITECTURAL CRITICISM.—PART 2.

My last paper confined itself to a statement that architecture possessed the same claims to open criticism as her sister arts;—my present design is to enforce those claims more strongly. The attempt then was to deprive taste of its precarious nature, and so to shake prejudice, as to prepare the mind for further illustration in proof of that statement; the present effort consists in reconciling an apparent discrepancy between the claims of architecture and the other arts, by displaying the peculiar features in which her poetry is cast, and by showing that though the mind be effected in a more remote and delicate manner, and that though an emotion, or an idea induced by it, be neither so animated, nor so vivid as another art might produce, yet that its effects are not the less faithful, nor less the result of a principle (whilst the principle itself emanates from nature); and hence, that if there be such a principle to guide the architect towards the material of his fancy, then architecture may remodel herself, and criticism may unbend.

One peculiar distinction of architecture appears to be in its compelling us when viewing the composition, to assume a suggestive or comparing attitude, and this necessity is consequent upon there being little that is strictly imitative in its phisiognomy or shape. This power of suggestion varies in degree, in the choice of features, and in the manner of their disposal. Where there is an introduction and classification of natural figures, so as to intrude on the province of the sculptor, the suggestive power of the art is shown in its faintest degree, for the imagination is in that case assisted by the presence of a familiar object, and the senses being palpably impressed, the mind has less effort to arrive at the final conception and emotion. The suggestive power in this case however still belongs to architecture, because it forms a feature in the whole, and because the architect exercises a discretionary power in the adaptation; but the features themselves are not so strictly suggestive as architectural features usually are

The strictly suggestive character is, where the object has no counterpart in nature, but where, from a certain attitude or proportion in the figure, assisted by relative position, the mind is left to suggest to itself an object in nature, expressive of some ideal quality, to which the figure might claim a point or two of resemblance.

In the comparison between the figure which has no counterpart in nature, and that which the imagination furnishes, there is extreme delicacy of perception requisite to detect a similitude; for, in exercising this power of comparison, we but transpose the elements of wit, since the strength of wit which consists in its delicacy is but the perception of a certain resemblance between two things, not essentially similar, but alike only in those features of which the idea takes cognizance. Two ideas in this case present themselves, and the relation found in those ideas, after the test of comparison, is essentially the product of wit. The relish which the mind has for this ingenious activity, the natural bias there is apparent in most of us, to indulge in this harmless intricacy of thought,—the pleasure too which we experience in detecting the force of an allusion, all imply an innate power in the mind to perceive a possible harmony or relationship between two separate and distinct things. It is in fact a self creative power, which for the time the mind exercises, by which out of apparently inapt materials, it shapes a perfect idea. Applying this to architecture, we may at once perceive the origin of the claim, which its inanimate features have upon us. Further to examine into the principle which moves us, we may perceive, that in the comparison of wit, however varied the play of fancy, or however apportioned the strength of perception may be, the ideas placed in juxtaposition, are not seen directly in the attribute of an object, but in that which is mostly associated with that attribute,—viz. the attitude or position by which we judge of the mind or intention. It is the external sign which wit first embraces, and not the inward evidence, and hence it is we comprehend the force of the ludicrous, (which is in truth the force of unexpressed wit) from figure, attitude, &c., our idea of pleasure arising from conflicting associations,—that is, from certain real or declared properties of the object, or of the mind through the object being seen connected with associations, which we perceive totally at variance with those naturally connected with them. It is upon this ground that we smile at the large head of a dwarf, or at the affectation of delicacy in a fat person, or laugh at the threatening attitude of a little slender man: therefore the pleasure of comparison is the pleasure of attitude; and inasmuch as this pleasure may be carried from wit to poetry, a definition of the poetry of attitude is necessary to assist in supporting the poetry of architecture.

The attitude of an object affects us then because we observe certain dispositions of the mind when exhibited, are frequently associated with certain attitudes, which, when unstudied appear natural, until from frequent observation that the same attitude is an index to the same disposition of the mind, we identify that attitude with it. It is this which has given personification to still life, and peopled nature with living beauty and grandeur. It is this same principle which has associated the willow with grief, and the oak with stubborn dignity;—which has detected modesty in a flower, or discovered wanton beauty in moving foliage. It is in truth the principle of life to the art of the poet, and it is by this that the poet is understood. The spectator of nature admits this in his own emotions, as he watches those objects which surround him, for he sees the graphic power of scenic poetry to consist in its picture of attitudes. The poet admits its influence still more delicately when he allows an attitude to invisible things. It was a consciousness of the poetry of attitude, that induced the lines:

> "'Tis sweet to listen as the night winds creep
> From leaf to leaf."

For whilst the ear is made sensible of the approach of the winds, the eye also may observe their furtive melancholy progress. It is thus then that attitude engages us, but attitude is not always significant of a collected state of mind;—there is often a carelessness about it which induces a different emotion from that attitude, which directly expresses an idea: it being always borne in mind that the object is for a time the personification of feeling and of will. A similar kind of effect is produced on the mind in such a case, only very faintly,—there being no definable idea connected therewith. It is very frequently the case in architecture that we feel the truth of this, as we revel amidst the smaller attractions of a composition, where we perceive about its minutiæ, attitudes, which we think beautiful, without knowing why. This innocent perplexity of thought which assails the mind, leaving it only when it has bewildered it, is the very secret of all the interest created: the reason being tempted into innumerable petty defeats, from each of which it arises to encounter a fresh one, as the several parts of beauty appear to seduce it on. It is here that criticism is disarmed,—criticism taking cognizance only of the position and extent of such attraction; and, it is because criticism is disarmed at this point, that architecture often exhibits such redundancy of beauty, which sickens the fancy and the taste. Attitude however has its carelessness, in a nearer approach than this to individual beauty, that is, where there is a more definite proportion traceable through its parts, though the same perplexity of the mind may be preserved; and it is in this state of attitude that we discover the beautiful in architecture, and by this are enabled to depict its ideal of grace or of grandeur. Byron beautifully illustrates this thought in his description of Dudù:

> Few angles were there in her form, 'tis true,
> Thinner she might have been and yet scarce lose;
> Yet, after all, 'twould puzzle to say where
> It would not spoil some separate charm to pare.
> She looked ————————
> The mortal and the marble still at strife,
> And timidly expanding into life.

Admiration of women in general, springs from the same subtle and exquisite cause: our ideas moving like the movements of sense amidst the same perplexities, becoming as we gaze, like the lovely cause, an elegant deceit For to admire woman requires not that we be absorbed by her mind, or her acquirements, since to appreciate either, we must turn to the cold test of a balance, or a criticism: nor do we descend to the base notion that she is the mere adjunct of pleasure, since poetry, the very element of her charms must then decay. No!—we seek her as a riddle,—we love her as an enigma,—we chase her through the follies of her course as a lovely inconsistency,—as a fanciful light we would snatch at and grasp. Our vanity tempts us to seize this for ourselves, which nothing seems to arrest, and to hug this creature of caresses, if only to rob nature of her dearest child.

Our ideas of grace and grandeur in architecture becoming then often those of attitude, as do those of the beautiful and sublime in nature,—grace, which we identify with no particular proportion when discovered in nature, becomes at once in attitude a lovely perplexity,—a creature of careless, yet correct shape, which, at a motion however slight, would take another form of elegance, as beautiful as she herself would be unconscious. Grandeur differs from grace, inasmuch as the energetic differs from the wanton, so that grandeur is always the creature of comparison, whose colossal form suggesting powers, contrasts itself with familiar trifles.

The principle which affects us has already been shown, but looking at this in a simpler and more homely guise, we may say that it is the poetry of attitude, which is the poetry of arrangement;—that is displays itself in domestic taste, and gives to the taste of a woman, that elegance and beauty so peculiarly her own. It is because her mind can engage itself in such gentle and beautiful comparisons,—because her perception of things is but a perception of their poetry,—because (which is a consequence) she allows nothing, and admits nothing around her, but such as can echo to her sensitively graceful mind, that her abode is replete with harmony, and beauty, and love.

Such is a feeble definition of the poetry of attitude, which is universal throughout nature, whether exhibited in her minuteness or her vastness, and such is a scanty description of that subtle faculty which extracts from her ever varying flowers, that honey which it hives for the nourishment of art.

Laboured as such reasoning may appear, inapplicable as such abstract considerations may be thought to the practical requirements of art, there is nevertheless in such an analysis, the exposure of poetry in its germ. There is, in testing our sensations by the varieties of nature, that secret spring opened into activity, which enriches the productions of art, and causes beauty, grace and grandeur, to start from the inanimate stone. There is, in generalizing our views, a liberality given to the mind, which deducing out of its observations, the true principles which affect it, begets an intuitive confidence in its own powers, to conceive and embody for the eye, its ever beauteous—ever endless creations. The deduction from the argument is, that if nature be the poet's laboratory, and if attitude prove to the mind one of her most operative principles, then, the degree of poetry in architecture bears a ratio (as far as attitude is concerned) to her power over attitude. It has already been shown by inference that she has this display of attitude, and that she embraces the same materials of beauty, which we see in external nature, therefore, as children of nature, we assert the poetry of our art. We know too that she has the same scenic effects from the lights and shadows she distributes; for when, as in the cathedral, these fall softly on surrounding objects, or when the eye sinks wearied from its awful wanderings amidst vastness and obscurity, to repose amidst beauties which peep from the dimest perspective, chords of joy swept by attitude vibrate on to entrance the senses.

So much for the principle which moves us, and so much for the argument in favour of architecture and her claims to criticism: yet, it must be borne in mind, that no more is attempted than to show a principle;—all illustration being consequent upon, and not connected with it:—the present attempt being solely to establish a claim to criticism, and not to dilate upon what it would be premature to consider, when attitude itself is merely subsidiary.

Space prevents further pursuance of a subject which would lead us away from attitude, to proportion, the questionable nature of which it was designed to sketch. Not wishing however to intrude further before the reader, the conclusion is reserved. However humbly these hints are delivered, or however feebly they may have been conceived, the writer knows that nature is adequate to the profoundest investigations, supplying as she does to every art the truest and the wisest rules, and that the more closely we adhere to her unchangeable maxims, the more dignified do we rise as artists, and as lovers of truth. He knows also that unless an art be capable of charming the senses, or of enriching, or of delighting the imagination, and can support its claims to such power, it is only a mockery of commendation to say that its compositions are governed by the most exact rules, and hence it is only a mockery to criticize:—"*ars enim, cùm à naturà profecta sit, nisi naturam moveat ac delectet, nihil sane egrisse videtur*:"—Cic. de oratore.

FREDERICK EAST.

October, 1841.

ENGINEERING WORKS OF THE ANCIENTS, No. 10.

THE present paper, which will be devoted to the Latin authors, will conclude this series, which, although far from being complete, is extensive enough to show that much may be done to illustrate the antiquities of engineering. C. J. Cæsar is the first author who comes before us, and in him we find nothing except an allusion to the mining skill of the Gauls, and an account, in Book 4, ch. 15, of the bridge he threw over the Rhine. In Sallust we find absolutely nothing. From Livy the gleanings are but few, an allusion to the works of the Tarquins in the first book; in the ninth book a statement that Appius Claudius Censor executed the Claudian aqueduct and Appian way; in book 39, a similar mention of C. Flaminius; in the 100th book, which is lost, there was an account of the drainage of the Pontine marshes. Quintus Curtius, in his 4th Book, ch. 2, has a long account of the siege of Tyre, and in Book 5, ch. 2, a description of Babylon. From Paterculus we have not been able to gain any thing, and Vitruvius we have left to the architects.

PLINY.

Pliny the Elder, who died A.D. 79, is to us one of the most interesting writers, for including in his work every department of the organic and inorganic world, we could scarcely fail to discover something of his value. We had occasion, however, last month to refer, in the review of Mr. Aikin's work, to some of Pliny's remarks on bricks, so that we are precluded from now giving them; the mining portion, we have also felt it necessary to exclude

BUILDINGS IN EARTHQUAKE COUNTRIES.

Pliny Book 2, ch. 82, recommends several modes of construction as calculated to resist the effects of earthquakes; he says that in some cases deep wells are advantageous, as they allow the dangerous gases to escape; that in some towns where there are many underground sewers, earthquakes are less felt; and that building on piles is extremely effective, as was to be observed in Naples, where the most solid part of the town is that which has suffered most. Brick walls, he also thinks, are less injured than others.

TUSCANS—ISTHMUS, &c.

In the 3rd Book, ch. 16, our author says that the Tuscans were the first to begin the canal system of the Po, by improving the Sagis. In Book 4, ch. 4, it is mentioned that King Demetrius, and the Emperors Julius Cæsar, Caius and Domitius Nero tried to cut a canal through the isthmus of Corinth but failed. In Book 31, ch. 3, is given a long treatise on wells, and chap. 6, on conduits.

INVENTORS.

Euryalus and Hyperbius, two brethren at Athens, caused the first brick and tile kilns, yea and houses thereof to be made in Greece. Gellius is of opinion that Doxius, the son of Cælus, invented the first houses that were made of earth and clay, taking his patterns from swallows and martens' nests. Cingra the son of Agriopa, first devised tiling and slating houses, as also found out the brass mines, both in the island of Cyprus, he also invented pincers, hammers, levers, and the anvil. Danaus sank the first wells in Greece at Argos. Cadmus at Thebes found out stone quarries first. Thraso was the first builder of town walls, towers and fortresses, according to some, but according to others the Cyclops and Tyrinthians. Lydus, the Scythian, or Delas the Phrygian, taught the art of casting and melting brass, and of tempering it, and the Chalypes or the Cyclops invented the forge and furnace for brass. Erichthonius or Æacus discovered the silver mines of Attica, and Cadmus, the Phenician, the gold mines of Mount Pangæus, and the mode of working and melting that metal, although by some it is attributed to Thoas and Æaclis in Panchaia, or to Sol the son of Ocean. Midacritus was the first who brought lead (query tin) from the island Cassiteris. The iron-smith's forge was first invented by the Cyclops. Coræbus, an Athenian, taught the art of casting earthen vessels in moulds. The weaver's spindle was invented by Closter, son of Arachne; the potter's wheel by Anacharsis the Scythian, or Hyperbios the Corinthian; carpentry, and carpenter's tools, as the saw, chipaxe, plane, hatchet, plumb-line, augre, gimlet, as also glue by Dedalus; and the rule and square, the level, the lathe and the key by Theodore the Samian. Pyrodes, son of Cilix, found out the way of striking fire from flints, and Prometheus the means of keeping it in a wick of the *ferula* or giant fennel stalk. Instruments of warfare and vessels of war owed their origin to many hands, but to the Syrians is attributed the catapult, to the Phenicians the balista, and to Epeus at Troy the ram. (Book 7, chap. 56.)

METALS.

In the 33rd book Pliny begins his discourse on metals, minerals and mining, this is continued in the 34th.

CEMENTS, BRICKS, &c.

It is in the 35th book that our author discusses the subject of pottery, He says that a means had been found out to make a strong kind of mortar or cement with the broken sherds of potters, if the same be ground into powder and tempered with lime, this is called Signina, and durable pavements are made in the same way. Puzzolana is next described, and other earths used for hydraulic cements as those of Cyzicum, Cassandria, Gnidos, Aulis, the Nile, &c. Afterwards came the several kinds of mud walls, pisee work, rubble, &c., and the several forms of bricks.

The 35th Book is descriptive of stones, marbles, &c., where it is said that Ethiopian and Indian sand was used in cutting marble. This Book also treats upon limes, mortars and pavements.

In thus concluding our labours on this subject, we trust that we may indulge a hope that we have not laboured in vain; it was our endeavour to show that engineering was no art or science of to-day, but one of the remotest antiquity, long practised and long honoured, and if in so doing we have in degree vindicated the claims of the engineering profession to distinction, we shall consider our exertions fully repaid. We may say with truth, that however trifling the result, they have cost us much research, long time, and the perusal of many volumes, which, as they rarely come under the student's inspection, so has he little time to devote to their perusal.

A NEW SAFETY VALVE.

SIR—If you consider the following worthy of insertion, you would much oblige by giving it a corner in your valuable Journal. It being well known that a compound bar of steel and brass will, on account of their different rates of expansion, assume a curved form on the application of heat, which property I propose to apply to a new safety-valve by the following means:—I would place such a compound bar in a curved form into a cylinder open at each end, having four arms radiating to its centre through which passes a rod fixed to the cylinder, and which carries at the other end a circular plate moving steam tight, of a fixed plate perforated with two or three holes for the escape of steam. Then the bar being set, so that the apertures in the fixed plate shall be covered at the proper working pressure of the steam, then if the temperature should by any means be raised, the bar will immediately cause the rod to turn and open the valve.

There are many mechanical details that are not mentioned, wishing only to set forth the principle.

I am, Sir,
&c. &c.

18th Oct.

FUNNEL.

Vienna.—"The Austrian government," says a letter from Vienna of the 16th of September, "has formed the gigantic plan of building at the eastern extremity of this capital, on ground which is wholly unproductive, a new town, capable of containing 50.000 inhabitants, and which is to be provided at the outset with all the requisite great public buildings, such as churches, residence of the governor, court of justice, exchange, theatres, museum, &c. This town is to be called "Ferdinand tadt." The plans are already made by the Chevalier Forster, architect of the Court, who before he submits them to the government, intends to communicate them to the principal academies of the fine arts in Europe, with a request to give their opinion."

MR. STEVENSON'S IMPROVEMENTS ON LEVELLING INSTRUMENTS.

Sir—In the minutes of the Institution of Civil Engineers which were published in last month's Journal, there was a notice of my improvements on levelling instruments; but that notice was not correctly given, and strangely enough omitted all mention of *two* of these improvements. I have therefore as a favour to request that you will give the following correct account of these improvements a place in your Journal, which may be considered to be the present acknowledged organ of the profession.

Levelling Staff.—The improvements on the levelling staff is as follows: the first is the introduction into the staff with sliding vane of an adjusting screw with clamp, by which, after the vane has been brought within $\frac{1}{4}$ or $\frac{1}{8}$ inch of being correct (which is readily done with the hand), the vane is firmly clamped, and the final adjustment up or down is at once made with the screw. A similar plan, I have since been informed by Mr. Manby, Secretary to the Institution of Civil Engineers, was used by Capt. Lloyd (Roy. Soc. Trans.), and also by Mr. Bunt, while prosecuting their scientific researches; but Capt. Lloyd's staff was only 6 ft. long, and Mr. Bunt's 9 ft., being too short for engineering use. The application of this arrangement to engineering purposes I have found of great utility. The above adjusting apparatus is for the vane when on the lower half of the rod, which is 12½ ft. long. But when the level line (*i. e.* the optical axis of the telescope produced) is above the lower half of the staff, the vane is as in all rods with sliding vanes, first clamped at the top of the upper half of the staff, which is then pushed or slid along the face of the lower half, until the vane is within $\frac{1}{4}$ or $\frac{1}{8}$ inch of being correct, when the *upper half of the rod* is clamped and finally adjusted up or down by a clamp and screw apparatus fixed at the back of the lower half. By this plan, although the vane may be far out of reach, the adjusting apparatus never moves, being a fixture and within reach of the hand, thus obviating the necessity of having a long adjusting wire fork for working a capstan-headed vane screw, which, although perfectly suitable for Mr. Bunt's *optimum* levelling would of course not answer the long rods used by engineers. The next improvement is *the combinations in one rod of all the advantages of the sliding vane staff, with vernier readings for accurate work, and the self-reading staff for rough work.* This is effected by having the back of the rod graduated to feet and decimals by means of inlaid bone figures which are read through the telescope level. In this way I have not lost sight of Mr. Gravatt's ingenious contrivance of self reading. In making a section where it is necessary, in order to carry forward a correct result, to be careful only with the first and last sights after and before moving the instrument, the intermediate sights are read off the back of the staff by the telescope. The above instrument, which is 12½ feet long, and may be said to consist of a sliding vane staff and a self-reading staff, is, by the contrivance of a late friend of mine, packed up in a box 3½ feet long and 4 inches square!

Level.—The first improvement in the level is the fixture to the telescope tube of a *circular level sluggish in its motions*, instead of the comparatively delicate cross bubble of Mr. Gravatt's level.

The last improvement is the introduction of a *ball and socket joint* between the head and legs of the instrument, so as to have a motion intermediate in fineness between that of the parallel plate screws and that of the legs. Before the introduction of the parallel plate screws, I understand that levels had a ball and socket motion instead of the screws. The present improvement consists in *restoring* the ball and socket for the *rough setting*, and at the same time *retaining* the parallel plate screws for the *final adjustment.* The clumsiness of the present arrangement consists in the instrument being at all dependent on the setting of the legs. With the instrument thus improved, the surveyor is made quite independent of the level of the ground where he sets the legs of his instrument, and may place them without regard to the inclination of the telescope to the horizon. Looking first to the circular level, and releasing the clamp of the ball and socket, he with one hand moves the head of the instrument till the bubble is in the centre of the circle, an operation which is done almost instantaneously. The socket screw is then clamped, and the telescope bubble is brought to the *absolute* level by a slight touch of the parallel plate screws. In this way the legs of the instrument need never be moved after the instrument has been placed on the ground, and the parallel plate screws have almost nothing to do, advantages which all who are accustomed to levelling will fully appreciate. I may mention that the price of altering my old level to the new form was 1*l.*, but I have no doubt that in future the charge may be less. That the above improvements are well worthy the attention of the profession I am fully assured, else I should not have brought them forward. My own experience on hundreds of occasions, as well as that of others, has placed any thing like doubt completely aside, and with the ball and socket joint I have been enabled on very many occasions lately to take in sights with one setting of the instrument, that would otherwise have required two, owing to very irregular and precipitous rocks, which did not afford sufficiently level rests for the legs to allow the bubble to be brought right.

I remain, Sir,
Your obedient servant,
THOMAS STEVENSON.

Little Ross Island Light House Works, Kirkcudbright.
Oct. 11, 1841.

ON THE ECONOMY OF FUEL IN LOCOMOTIVES CONSEQUENT TO EXPANSION AS PRODUCED BY THE COVER OF THE SLIDE VALVE.

Sir—The confidence of anonymous writers is sometimes exceedingly amusing. For reasons best known to themselves they seem to put but little value on the idea that they themselves may perhaps be labouring under misapprehension; and such is singularly the case of a gentleman signing himself M., the author of a letter in your October number, containing some strictures on a paper of mine in your August number, on the subject which is the title of this letter. This gentleman, Mr. M., having discovered, he says, some errors in my calculations, hopes you will allow him to point them out for the benefit of your readers; and he begins by premising that although some formulæ of mine, which he points out, are correct, yet in two of them there are expressions which are identical, and which, he says, might perhaps be better expressed, now whether or not these expressions are identical, any schoolboy can find out, and whether or not they are identical, I hope Mr. M. will have the generosity to allow me to suppose them better stated in the form I have adopted. Mr. M. now proceeds to state that the value of (*s*) (*s* being the area of the piston) is incorrect, and that it is impossible to deduce the area of the piston from the length of the stroke cover and lead of the slide, and ratio of the greatest to the least pressure of the cylinder, without knowing how much steam is generated in the boiler. If Mr. M. would have the goodness to read over again a part of my paper, he would find it there stated that in the mode of expansion virtually adopted in locomotives, the cylinders are enlarged so as to consume the same quantity of steam, (which is just the whole steam that the boiler can produce); and this is the only way in which the question of advantage from expansion can be treated; now if Mr. M. would consider for a little he would see that what I am about with the equation,

$$s\left(a' - \frac{(2\,d - b)\,t}{p}\right) = 2\,d \times 1$$ is finding what area the piston must have so that the steam may be cut off at (a'), and yet the same constant quantity of it consumed, and he would see that so far from being able to give (*s*) any value we please, it can on the contrary have only one definite and particular value, which is assigned by this equation, and so far from $2\,d \times 1$ being an arbitrary quantity, it is the very quantity that properly represents the quantity of steam produced by the boiler, or which is the same thing in the question under consideration, the volume that the cylinder would have if no expansion took place.

Mr. M. in the next paragraph leads me to doubt if he understands the mode of analysis it is necessary to follow in estimating the work performed by an engine working expansively, for the expression $\frac{a'\,p}{x} - t$ does not express the effective working pressure during the expansion, and only at that part of expansion where the piston is at a distance (x) from the beginning of the stroke; and how he has discovered that this gives the effective working pressure 3 or 4 lb. per square inch too much he does not mention, and I am unable to find out. Mr. M. mentions that I make no allowance either for the diminution of temperature of the steam during the expansion, or the waste space which has to be filled with steam. Perhaps Mr. M. for the benefit of your readers will be kind enough to tell us how much the temperature of the steam will be reduced in the hot climate of a locomotive's smoke box? Would Mr. M. seriously propose to introduce into this analysis the slight modification necessary for the waste space filled by the steam; which waste space varies in all locomotives, and will yet be reduced to almost nothing? Again, Mr. M. states that the effect during the part of the stroke from the opening of the eduction port the termination of the stroke, must not be neglected on account of the small opening of the port during that period, and that the pressure of the steam is previously very little reduced by expansion. Mr. M. ought to have told us what degree of expansion he alludes to, as that altogether decides the extent of diminution of pressure by expansion, and when he considers that at this part of the stroke the motion of the piston is very slow, and the motion of the valve very quick, he will be able to see that the contemplated effect of this part of the stroke is considerable. Mr. M. next states that the effect of the compression of the educted steam is so small that it might be disregarded. I am sorry to see Mr. M. make such a remark, after having read the last paragraph of my paper, as the effect of this compression is altogether dependent on the extent of the cover and the lead.

Mr. M. in his concluding paragraphs has got into a sad maze, he supposes that I put the initial pressure of the steam in atmospheres equal to the area of the piston, and founding upon this most wonderful equation some beautiful deductions, he states that "these results show the manifest absurdity of the supposition." If Mr. M. would substitute for the letter (*s*) the figure (5), he would immediately be relieved from a multitude of his difficulties, and you are able to say whether the letter or the figure is in my paper. With the assistance of these remarks, perhaps Mr. M. will find out that the paper which he states requires "revision and correction" virtually less requires either than his own letter.

And I am, your obedient servant,

J. G. LAWRIE.

Cartsdyke Foundry, Greenock,
October 6, 1841.

SIR—I regret exceedingly that any expressions contained in my letter concerning Mr. Lawrie's communication on the Economy of Fuel in Locomotives consequent to Expansion as produced by the cover of the Slide-valve, and which you favoured with insertion in your Journal for this month, should have given that gentleman offence, as I perceive by his letter, which you were kind enough to send me for perusal, to have been the case. I therefore take the earliest opportunity of assuring him, through the medium of your columns, that such was perfectly unintentional, and also of acknowledging two errors into which I had fallen, though not altogether by my own fault, as I think I shall now show. In the first place I objected unjustly to his equation

$$s\left[a' - \frac{(2d-b)t}{p}\right] = 2d \times 1;$$

in which he merely stated (*s*) to be the area of the piston, having inadvertently omitted to mention at the same time that the area of piston required to use the same quantity of steam without expansion was considered as unity, so that (*s*) is not the absolute, but the relative area of the piston, or the ratio of its area when the steam is cut off after the piston has travelled a distance (a') to what it would be if the steam were not cut off at all; and I think Mr. Lawrie will allow that any other reader would be liable to be led into the same mistake as myself through this oversight on his part.

The second error which I have to acknowledge is the having attributed to Mr. Lawrie the absurd hypothesis that the safety valve be so loaded that (*p*) is equal to (*s*) (which he would have seen to be so printed in the Journal, if he had taken the trouble to refer to it before writing his letter), whereas I ought to have supposed it to be a misprint, as in fact it is, and I now see clearly that the (*s*) was intended by Mr. Lawrie for a (5).

I shall now endeavour to convince Mr. Lawrie that the rest of my remarks were not thrown out without due consideration.

First then, although a school boy might have been able to find out that the two expressions alluded to in the first part of my former communication were identical, if the problem had been proposed to him, yet I should very much doubt whether he would see it at a glance, without having any previous suspicion of the fact; but, having discovered it in the course of my investigation (for which discovery, however, I beg to be understood to claim no particular merit), I thought it would be useful to communicate it to your readers, since it saves the trouble of calculating the same quantity twice over by two different methods.

I have now to return to the equation already quoted above, in the second member of which the factor (1) expresses the area of the piston when there is no expansion, and (*s*) its area when the steam is cut off at (a'), the same quantity of steam being admitted during the stroke in both cases; and with this explanation I acknowledge the correctness of the above equation, except inasmuch as the waste space at the end of the cylinder, which has to be filled with steam as well as the length (a') of the cylinder, has been omitted in the account (and this Mr. Lawrie must excuse me from admitting to be *reduced to almost nothing*), and also inasmuch as the pressures (*p*) and (*t*) are used instead of the corresponding densities of the steam. The Count de Pambour, in his *Treatise on Locomotive Engines*, and *Theory of the Steam Engine*, assumes this waste space to be equal to $\frac{1}{20}$ of the contents of the cylinder within the limits of the stroke of the piston, and I believe this estimate to be, in all cases, rather below than above the truth. Besides, where is the necessity or advantage of neglecting that quantity, when there is no difficulty in taking account of it, at least by approximation? Its actual value may be employed, when known, otherwise by using an approximation such as $\frac{1}{20}$ a more correct result would be obtained than by omitting it altogether. The above equation, corrected for the waste space, and with the substitution of the densities (δ) and (δ') for the pressures (*p*) and (*t*) respectively, becomes

$$s\left[a' - \frac{(2d-b)}{\delta}\delta' + w\frac{\delta-\delta'}{\delta}\right] = 1 \times \left[2d + w\frac{\delta-\delta'}{\delta}\right],$$

whence

$$s = \frac{2d\,\delta + w(\delta-\delta')}{a'\,\delta - (2d-b)\,\delta' + w(\delta-\delta')};$$

where (w) expresses the length of a portion of the cylinder equal to the waste space at either end of it.

In order to show that the corrections which I have introduced, although not greatly affecting the result, amount notwithstanding to something appreciable, I shall presently apply them to one of the examples at the end of Mr. Lawrie's former communication; but it will be necessary first to make a further correction in the latter, which I shall do as soon as I have replied to the remaining paragraphs of his present letter.

With regard to my understanding the mode of analysis it is necessary to follow in estimating the work performed by an engine working expansively, I am sorry the want of perspicuity in my former letter was such as to create a doubt in Mr. Lawrie's mind, and I trust I shall now succeed in dispelling it; indeed the doubt has arisen from his assigning a more extended signification to an expression, which I used in common with himself, than the said expression had any right to bear, or was originally intended to bear by either of us. When I said that he found the *effective working pressure* during the expansion to be equal to $\frac{a'p}{x} - t$, I did not mean the *mean effective working pressure*, nor could I mean that that quantity, which so evidently varies with the value given to (x), could be supposed constant during the whole of the expansion, but precisely what Mr. Lawrie himself meant, viz., that it was the general expression of the *effective working pressure* during expansion, the particular value of which at any given instant would be found by substituting for (x) its value for the position of the piston at the given instant. This is, however, merely a misconception on the part of Mr. Lawrie, who no doubt thought my objection rested on the supposed difference which I have just explained away, whereas the real point at issue is whether the constant term (*t*) in the above expression faithfully represents the negative part of the effect, or the resistance of the waste steam on the back of the piston, or not. Now (*t*), as I stated in my former communication, is used by Mr. Lawrie to express the *lowest* pressure of the waste steam in the cylinder, which probably scarcely exceeds the pressure of the atmosphere, and he has likewise used it for the *mean* resistance of the waste steam, that is, the resistance due to the blast pipe added to the pressure of the atmosphere, during the whole of the portion (*b*) of the stroke. Now, according to the Count de Pambour's experiments, with the mean evaporation of locomotive boilers, and the size of orifice of the blast pipe commonly adopted, the mean resistance due to the blast pipe, when the velocity of the engine is 20 miles an hour, is 3½ lb. per square inch of the piston. In the description of Robert Stephenson's patent locomotive engine in the new edition of Tredgold on the Steam Engine, page 451, it is stated that that resistance is "6 lb. per square inch when running at the usual rate of 25 or 28 miles an hour," and that at greater velocities it "has been found to increase to double that amount, and even more." I think I am therefore fully borne out in the opinion that Mr. Lawrie's calculation makes the effective working pressure (I should have added, on the average) 3 or 4 lb. per square inch too much, if not more.

With respect to the diminution of temperature consequent on expansion, Mr. Lawrie must surely be aware of the possibility of reducing the temperature of elastic fluids, by sudden dilatation, many degrees below that of the surrounding bodies; but, since he wishes me to tell him how much the temperature will be reduced in the hot climate of a locomotive's smoke-box, I answer that, when the time given for expansion is excessively short, as it is in locomotives, this reduction is not sensibly affected by the climate, but depends on the primitive pressure and degree of expansion of the steam, and that in his 3rd example, where the steam is (supposed to be) cut off at 5·2 inches from the commencement of the stroke, the diminution of temperature would, with that expansion, amount to about 80 degrees; but this is much greater than it would be in reality, on the hypotheses made by Mr. Lawrie, because the values found by him for *(a')* and *(b)* are so much too small as to exaggerate the expansion enormously; as an instance of which, in the example just quoted, these valves ought to be 0·7726 and 0·9259 respectively, instead of 0·2884 and 0·7, and the steam would consequently be cut off at 13·9 inches, instead of 5·2, from the commencement of the stroke. This error, which runs through all 4 examples, and thus vitiates all the deductions, arose from Mr. Lawrie inadvertently changing the unity from the radius of the eccentric to the width of the port, in applying his formulæ.

Mr. Lawrie says that, when I objected to the omission of the effect of the steam during the part of the stroke from the opening of the eduction port to the termination of the stroke, I ought to have told you what degree of expansion I alluded to, as that altogether decides the extent of diminution of pressure by expansion. This is sufficient reason for not neglecting the quantity in question; for if there is any degree of expansion for which it ought not to be neglected, the only way to be sure of not doing so in that particular case is to include it in the general formula. However, I will take Mr. Lawrie's 2nd example, where the lead (on the steam side) is $\frac{1}{6}$ of the breadth of the port, and the cover (also on the steam side), $\frac{1}{2}$ breadth of port. Mr. Lawrie assumes that the valve has no cover on the eduction side of the port, which I think he will not find to be exactly the case; Mr. R. Stephenson allows $\frac{1}{16}$ inch on each side, and the ports are only 1 inch wide, which makes the cover on the eduction as well as the steam side of the port, $\frac{1}{16}$ of its width. It is obvious that this arrangement causes the eduction to commence later, by which means the pressure of the steam is not reduced so low at the end of the working stroke as it would otherwise be. It is, however, with the conditions assumed by Mr. Lawrie that I have calculated, at a great cost of time and labour, what the diminution of pressure would be in this example, from the opening of the eduction passage to the end of the stroke. I have supposed the initial pressure (before expansion) to be 5 atmospheres or 73·53 lb. per square inch, and the total area of the port $\frac{1}{10}$ that of the piston, and I have purposely made the reduction of pressure come to more, rather than less, than it would really amount to.

The radius of the eccentric, or $\frac{1}{2}$ the travel of the valve, which is called unity in the formulæ for calculating *(a')* *(b)* and *(c')*, is equal to the width of the port + the cover $= \frac{3}{2}$ width of port, whence the width of port $= \frac{2}{3}$, and $l = \frac{1}{9}$, $c = \frac{1}{3}$. With the aid of these values we find $a' = 0{\cdot}8482$, $b = 0{\cdot}9479$. Neglecting the waste space, the pressure is reduced by expansion to 65·07 lb. The eduction lead = the lead + the cover on the steam side $= \frac{2}{3}$ width of port, which is the extent of opening to eduction at the end of the stroke; and the crank is 26° 23′ 16″ from the dead centre when the port begins to open. This I have divided into intervals of 1°, and have computed the discharge of steam during each interval, supposing it due to the difference between the pressure *at the beginning of the interval* and the pressure of the atmosphere. This calculation is consequently very long, but I believe there is no formula yet discovered which gives the discharge during the whole time at once. I found in this manner that the pressure would be reduced at the end of the stroke to 52·87 lb., or 38·16 lb. above the atmosphere, which gives a mean pressure during the eduction lead of at least 44·26 lb. per square inch, or distributed through the whole length of the stroke, 2·31 lb. This, I think, Mr. Lawrie will not call *inconsiderable*; while the effect of compression would certainly not surpass, if equal, 0·4 lb. per square inch through the stroke, which I consider rather to be neglected than the former.

I shall conclude my letter with showing, as I stated above, that the corrections I introduced into the value of *(s)* are not altogether to be neglected, and for that I shall apply them to the example chosen above. By Mr. Lawrie's formula, we have

$$s = \frac{5}{4{\cdot}211 - 1 + 0{\cdot}9179} = 1{\cdot}1936.$$

By the corrected formula, making $2\,d = 1$, $\delta = 1$, $\delta = 4{\cdot}3557$, $w = 0{\cdot}05$, we have

$$s = \frac{4{\cdot}3557 + 0{\cdot}1683}{3{\cdot}703 - 0{\cdot}0521 + 0{\cdot}1683} = 1{\cdot}1872.$$

The difference is certainly not very considerable, being only about $\frac{5}{9}$ per cent. on the required area: but why should even that correction be omitted, when it can be applied without any difficulty and with scarcely any additional trouble?

I am, Sir, your obedient servant,

M.

October 14, 1841.

CROSBY-PLACE, BISHOPSGATE STREET.

The committee appointed to superintend the restoration of this most interesting specimen of ancient domestic architecture appear to have brought their labours nearly to a close, and an inspection of the result of those labours will secure the praise of every lover of our architectural antiquities. It is highly gratifying to witness the timely preservation of a building which is "the only example of any magnitude of the halls and places of our forefathers in the metropolis, the numerous other buildings of this nature which once graced the city having fallen victims to the great fire, or the no less destructive hand of innovation. The reparation appears to have been carried forward as far as is desirable until the particular use to which the hall is to be hereafter applied shall be ascertained; and most fervently do we hope that it may be such as shall best accord with its present beauty and its past history. The new materials and workmanship harmonize so thoroughly with the original, as to render it impossible, except on the minutest inspection, to distinguish between the new and the old. The matchless beauty of the roof in the hall has been effectually preserved. This unique specimen of timber-work is remarkable for the skilful omission of ties and hammer-beams. It is divided into eight principal compartments in length, and four in breadth, the points of intersection being ornamented with light and graceful pendants, pierced with small niches, each pendant forming the centre of four arches, so that from whatever point it is viewed the eye is presented with a series of arches of elegant construction. The principal timbers are richly decorated with bosses of foliage, and "spring from octangular corbels of stone." It is remarked that the low pointed arch, approaching to an ellipse, is admirably calculated for the dissemination of sound. "The shafted oriel," notwithstanding all the rough usage to which it has been exposed, has recovered its pristine beauty, and, as well as the other windows, is "richly dight" with the stained glass armorial bearings of the former proprietors, and of the various companies and individuals of whose munificence the hall itself will be the lasting memorial. From some sources, of which we are ignorant, the council chamber and throne-room have been restored to a state of great beauty; not, indeed, on the same scale of magnificence as the hall, to which alone the public subscriptions have been devoted, but yet in a style perfectly in keeping with the age and character of the structure. When Crosby-place shall be transferred to the hands of its next possessors, these rooms will probably receive all those rich decorations which will enable them to vie with the splendour of a hall. It is, however, from its historical associations that Crosby-place must ever derive its greatest value and interest. In the reign of Edward IV., it was the magnificent home of Sir John Crosby, its reputed builder, who was here probably honoured with the presence of that Monarch whose cause had been so greatly strengthened by the zeal and prudence of his princely host. It is well known to have been afterwards the abode of Richard III.; Shakspeare has immortalized the fact, so that "Richard, Shakspeare, and Crosby-place, must ever be identified." Here Sir Bartholomew Read, Mayor of London, entertained a solemn embassy from Maximilian, Emperor of Germany, of which Lord Cassimir, Marquis of Brandenburg, his cousin, accompanied with a bishop, an earl, and a great number of gentlemen well-appareled, was principal embassador, which were triumphantly received in London, and were lodged at Crosby-place." Sir Thomas More, the witty and unfortunate author of the *Utopia*, when in favour, occupied Crosby-place, and afterwards sold it to "his dearest friend" Bouvisi, the Lucca merchant. In 1594, it was purchased by "the rich Spencer," who died possessed of nearly a million of money, and was an ancestor of the present Marquis of Northampton. Here he entertained no less a personage than the Duke of Sully, the Ambassador of Henry IV. of France. Among the sub-tenants in the early part of the 17th century, we find a name immortalized by Ben Jonson's most beautiful epitaph, "Sidney's sister, Pembroke's mother," and William Russell, probably a scion of the noble house of Bedford. In the disastrous period of the civil wars it was used as a prison for the Royalists; and in 1662, the Reverend Thomas Watson was the first ejected minister who officiated in the hall: he converted it into a Presbyterian meeting-house. He was followed by Stephen Charnock, Dr. Grosvenor, a pupil of Benjamin Keach, and Edmund Calamy, jun. The congregation continued to meet here till 1769, when it was dispersed, a farewell sermon being preached on the occasion by Mr. Jones, the predecessor of Dr. Collyer, at Peckham. The hall, as every one knows, became subsequently a common warehouse, and fell rapidly into a state of ruinous decay, from which degradation it has now, at length, been recovered. Thus, for nearly four centuries, has this beautiful structure remained, the witness of decent hospitality, of boisterous mirth, and of merry wassail; at one time its "rich embowed roof" and arras-covered walls echoing the sweet music that arose from the minstrels' gallery; those walls then denuded of their costly draperies, and resounding with the groans and oaths of the Cavaliers, and once again consecrated by the solemn psalms and hymns of the Presbyterians; and now, rescued from the dust and noise and bustle of the packer's warehouse, it silently waits to witness the mysterious future, and again to see "one generation passing away, and another coming."—*Correspondent of the Times.*

LIFE OF ST. ETHELWOLD.

By HYDE CLARKE, Esq., F.L.S.

THE end of the tenth century is famous in English history for the great extension of the Benedictine order, and of monastic buildings, effected by St. Dunstan, Archbishop of Canterbury, and his two coadjutors, St. Oswald, Archbishop of York, and St. Ethelwold, Bishop of Winchester. These were men of remarkable ability, forming a constellation of talent, which might well affect the monkish writers with admiration, and arrest the attention of the historian. Under their direction King Edgar lavished the wealth of his kingdom on the Benedictines, and he was able to boast of having erected fifty monasteries, many of which flourished in splendour for above 600 years, and became the germs of some of our finest monuments. The reign of Edgar indeed, forms an epoch in our architectural history, and as to St. Ethelwold was committed the direction of the material part of this revolution, it cannot be uninteresting to architects to contemplate the deeds of this ornament of their profession, of whom it is to be regretted that no modern memoir has yet been written.

Ethelwold was born towards the end of the reign of Edward 1st, surnamed the Elder, between the years 910-20, in the imperial city of Winchester, then the metropolis, and was the son of opulent, respectable, and pious parents, his birth, according to the legends, being preceded by omens of his subsequent greatness. St. Swithin and Daniel, Bishops of Winchester, were also natives of the city, as was Ethelwold's after colleague, St. Oswald. Having at an early age shown most pious dispositions, Ethelwold attracted the notice of the illustrious King Athelstan, in whose palace he, with Dunstan, for some time lived, and by whom he was afterwards placed under the care of St. Alfege the Bald, Bishop of Winchester, uncle of St. Dunstan. Having attained the proper age, and having previously received the minor orders, he was consecrated priest by St. Alfege, in the cathedral church at Winchester, at the same time with St. Dunstan, and it is supposed about the year 936 or 937. Besides Dunstan and Ethelwold, there was another priest ordained, who was named Athelstan, and who afterwards relapsed into a bad life, and Bishop Alfege is said on this occasion to have prognosticated the several careers of the young men. Ethelwold soon after retired to Glastonbury, and put himself under the care of his friend Dunstan, who had introduced into that house the rule of St. Benedict. Here Ethelwold afterwards became Dean, and must have been present, and no doubt co-operated, at the period when St. Dunstan was engaged in rebuilding the monastery.

At Glastonbury Ethelwold greatly distinguished himself, not only by his scholastic acquirements, and by the skill with which he taught grammar and prosody, but by his great industry, labouring with his own hands, and even cooking and performing menial offices. Being seized with an ardent desire of acquiring knowledge, the dean had intended to travel on the continent, but was prevented from carrying his design into execution by the Queen-mother Edgiva. This princess was the daughter of Sigeline, a Kentish earl, and mother of King Edmund 1st, and the reigning King Edred, whom she advised not to allow such a man as Ethelwold, whose wisdom and acquirements she highly praised, to leave his kingdom. The king, pleased with hearing such a character of Ethelwold, took great interest in him, and at the persuasion of the Queen-mother, gave him an estate at Abingdon, with the charge to restore an ancient monastery, then greatly dilapidated, consisting of a wretched building, and only possessing 10 manses. This event is generally said to have taken place in 954, but according to Ingulf and the Croyland charters, it was six years before, namely in 948. With the consent of his abbot Dunstan, and no doubt by his influence, Ethelwold went to Abingdon with Osgar, Feldbert, Friwegar of Glastonbury, Ordbert of Winchester, and Edric of London, and soon collected a body of monks, of whom he, by the king's wish, was ordained Abbot, and he then set himself to work, by head and hand, to carry out the task imposed upon him. From the king he obtained large estates at Abingdon, and a grant from the treasury, and he found in the queen-mother a liberal benefactress. From the king Ethelwold obtained a charter of ample privileges, which he himself appears to have illuminated. On a certain day the king came to the monastery, laid the foundations himself, and measured them out, giving directions also how the works should be prosecuted. At the banquet given in honour of this occasion, Ethelwold is represented by his biographers as having begun his career of miracles, by a prodigy much better suited to the taste of those times than of these, having furnished to the numerous Northumbrian guests an inexhaustible supply of wine from one jar. It appears to have been the practice in these days to board the workmen, and one of the legends relates that the monk who had the charge of supplying the workmen with provisions was named Alfstan, and that he performed his duties most laboriously and assiduously, not only cooking and serving out the provisions, but himself lighting the fire, drawing water, and cleaning the dishes. Abbot Ethelwold, seeing him one day engaged in performing his accustomed duties, begged him to dip his naked hand in the caldron, and to reach a piece of meat, which Alfstan did without scalding his hand, a proof of the religious purity of himself and the abbot, and of their unrefined manners. Among Ethelwold's gifts to Abingdon, most of them the work of his own hand, were a gold sacramental cup of great weight, three crosses of pure silver and gold, lost in the troubles of Stephen's reign, and candlesticks, censors and other vessels for the service of the church of pure silver, and some adorned with precious stones. Many of these were afterwards carried off by a Norman monk of Jumieges. At the request of King Edgar, Abbot Ethelwold also made a silver altar table of the weight of three hundred pounds, and which long remained admirable for the delicacy of its workmanship. He also made two bells with his own hands, and put them in the belfry with two larger ones, which had been made by St. Dunstan. Another of Ethelwold's works was a kind of chime consisting of a wheel full of bells, called the golden wheel, on account of its being gilt, and which was used on high festivals. Abbot Ethelwold was famous for preserving the sanctity of manners of his flock, but he seems to have been by no means illiberal as to matters of eating and drinking, his allowances to the monks being so bountiful as to become matters of proverb. As a ruler of the monastery Ethelwold acquired the highest reputation, and formed a school for singing and reading the service, to which persons from all parts of England resorted. Being greatly desirous of securing uniformity in the mode of performing the service he sent to Corby in France, then famous in this respect, and obtained some skilful monks as instructors. He also sent one of his monks, named Osgar, to the Benedictine Abbey of Fleury to study the rules of the order in that school. This Osgar, there is reason to believe is the one who succeeded our Abbot at Abingdon. Ethelwold exerted himself to a great degree for the advancement of his house, for which he obtained more than six hundred cassates of land, and charters from Edred and Edgar. One of his chief works at Abingdon was a cut which he made from the river Isis to supply the abbey with water, and also to work a mill, which he built. While digging for this canal the excavators found in the sand near the monastery of St. Helen, an iron cross, which Cessa, Viceroy of Wessex, and founder of the old abbey, had caused to be laid in the tomb on his breast. This cross was translated to the abbey, and became famous under the name of the Black Rood or Cross, upon which no one could take a false oath under pain of death, for it was believed to be partly made out of one of the nails of the cross, and sent by Constantine the Great or some of his British followers to England. It is further related that the monks having sometimes attempted to adorn this cross with gold or silver, as fast as they put it on one day it fell off and dissolved on the next. Abbot Ethelwold's zeal for his monastery was great, working even with his own hands, and having as his biographer states, attracted the especial despite of the devil, had on one occasion a heavy beam thrown at him by the great enemy, which knocked him into a pit and broke several of his ribs, and if it had not been for the pit the Abbot would have been crushed to pieces. As it was he soon recovered. Under his government the house prospered in sanctity, and a young boy, who was a favourite of the monks, had on his death-bed a beatific vision of the glories of heaven.

The time was now arrived when the talents of Ethelwold were to shine in a still more extensive sphere, the unfortunate King Edwin, pursued by the monks, had lost the greater part of his dominions, which had rebelled to his brother Edgar, and in 959 this patron of the monastic order obtained by the death of his brother the undivided rule of the whole empire. In 958 Edgar had granted a charter to Abingdon, and in 960 at Dunstan's request he chose our Abbot to undertake the work of the restoration of Evesham, who went there, restored the monks and appointed Oswald Abbot. Of Ethelwold's subsequent government at Abingdon, we have nothing more to relate than that having made that abbey one of the great schools of learning and piety, it became the nursery, whence the new monasteries of King

Edgar were supplied with pastors. A prayer for the prosperity of Abingdon remains as a monument of Ethelwold's love for that institution, and as a testimonial of his scholarship.

In 963 Brithelm, Bishop of Winchester, having died, Ethelwold was appointed to succeed him, and thus became bishop of his native city, which as before said was then the metropolis of the country. On St. Andrew's eve in this year which fell on a Sunday, Ethelwold was consecrated by Archbishop Dunstan, and immediately entered on his labours, finding his cathedral greatly needing repair, and what affected him more his canons of irregular life. In 964 we find Bishop Ethelwold's signature to three charters of Worcester Abbey, and it was in the same year that he was engaged in the restoration of Chertsey monastery in Surrey, sending to Abingdon for thirteen monks of whom Ordbert, a fellow townsman of the Bishop's, and originally of Glastonbury monastery, was appointed Abbot. In 965 we find the Bishop busy with the reform of the two monasteries at Winchester, in which he had great difficulties to contend with. Only three of the canons, Edsy, Wulsy and Wilstan could be induced to put on the cowl, the others retired, and were replaced with monks from Abingdon. Some of the displaced canons attempted to revenge their disgrace by giving the bishop a poisoned cup, but he soon recovered from the consequences. The result of these discussions was the holding of the two celebrated councils of Winchester and of Calne, at the first of which the cause was given against the seculars by a miraculous voice from a crucifix, and at the latter, on Dunstan appealing to God, the floor sank down and the adversaries of the monks were precipitated among the ruins, Dunstan and his friends remaining safe. In the preparation for this second miracle it is more than probable that Bishop Ethelwold was concerned.

Ethelwold was now high in power, holding one of the chief episcopal dignities, a minister, confident and confessor of the king, he took a great part in public events. Ethelwold is described with some prejudice by Sharon Turner as a man bred up by Dunstan himself, and of a temper to execute all his schemes. Dunstan was about the same age as Ethelwold, if anything rather younger, and although associates in their youth, and at Glastonbury, it could not with justice be said either by Florence of Worcester, or Adelard, that Ethelwold was brought up by Dunstan. Oswald, was like St. Dunstan, of high connexions, a native of Winchester, and partly educated there, and these two with Ethelwold formed a cabinet, which however obnoxious it might be for some of its schemes, yet it is not to be denied that it greatly promoted the prosperity of the country. Edgar and his ministry greatly patronized foreigners and trade, delivered the country from the scourge of wolves, reformed the coin, improved the navy, and the administration of justice. To return to the immediate exertions of Ethelwold, we learn that he rebuilt and re-established the Abbey of Benedictine Nuns at Winchester, and placed over it, Etheldritha, who had been his nurse. He also rebuilt the other two Benedictine monasteries. In 966 the site of the monastery of Medhamstead was bought by Ethelwold, and a magnificent abbey built, which was named by him Peterborough. According to Hugh Whyte, the Bishop was warned of God in the night that he should go to the Midland English or Mercians and repair the monastery of St. Peter, and that taking his journey into those parts he came to Oundle, supposing that to be the place, but was warned a second time, that he should follow the course of the river, he came to Medhamstead, and here the Lord appeared to him a third time and directed him by a singular omen, how he should proceed. Having cleared the site of the church, which he found used as a receptacle for herds of cattle, he returned to Winchester to make preparations for the restoration of the monastery. When having put up fervent prayers to God to incline the hearts of King Edgar and his queen and his court, to contribute their assistance to this work, he was overheard by the queen, who thenceforth solicited the king for its reparation, and he accordingly patronized the undertaking. Ethelwold among other measures purchased the fourth part of Whittleseamere, and many other endowments. In this same year he signed a charter for Croyland Abbey, and for the abbey of Hyde, at Winchester, and at London in the end of the same year, he united with the archbishops and bishops in a deed threatening the censures of the church on any disturbers of Croyland.

In 968 the Bishop attached his signature to two charters of Wilton Abbey, and it was most probably about this time that he received at that convent the vows of St. Wiltrude or Wulftrude, the mother of St. Edith. In 969, the distinguished scholar Alfric who was a pupil of Ethelwold's, was appointed Abbot of St Alban's. In 970 the Bishop translated the relics of St. Swithin from the churchyard of Winchester to the cathedral. In this same year although much occupied with his disputes with the monks at Winchester, Ethelwold was appointed by the king to restore the convent of Ely, and having obtained the Isle of Ely free of regal jurisdiction, he dismissed the priests, gave orders for repairing the church, and established therein a convent of monks. Brithnoth, who had been prior of Winchester, was appointed Abbot, and was succeeded at Winchester by Leo the provost. Brithnoth who was consecrated by Dunstan and Ethelwold, was afterwards unfortunately assassinated by order of the Queen Dowager Elfrida for refusing to comply with her passions. For Ely the Bishop obtained many grants of land, and he was a subscribing witness to two of its charters. In this year Ethelwold succeeded in completing Peterborough, and King Edgar being desirous to see it went thither, with the Archbishops Dunstan and Oswald, and attended by most of the nobility and clergy of England, who all approved and applauded both the place and the work. It was Ethelwold's happiness also to discover some very ancient charters bestowing great privileges on the place. It is to be remarked that at this time the prelate was constantly engaged travelling about, superintending the works, and examining the convents. During one of these journies it is related that performing mass in a country parish, the priest whose duty it was to take care of the sacred oil, having left the vessel behind him on the road, went back to find it, and to his surprise not only found it safe, but marvellously replenished.

In 971 the Bishop attached his signature to two charters for Ely, and the next year he prevailed upon Edulf, chancellor of King Edgar, instead of going to Rome, to labour in the restoration of St. Peter's church at Peterborough. Edulf approving of this advice, accompanied the king to Burgh, offered all his wealth to the monastery, assumed the monk's habit, and became first abbot of Peterborough, which he afterwards left for the archiepiscopal seal of York. In 973 Ethelwold subscribed the charters of Ramsey and Thorney. In the succeeding year the Bishop was at Wilton, signed one of the charters, and received the vows of St. Edith, natural daughter of King Edgar and St. Wulftrude. The Bishop used to visit Wilton from time to time, and on one occasion reproved St. Edith for wearing splendid garments, not being aware that she had haircloth next the skin. Edith replied that the Almighty looked not to the garment, but to the soul, and that he would as well receive her with splendid robes as in the attire of poverty. The Bishop in this year (974) translated the relics of St. Withburga and other saints into the new church at Ely. This same year Ethelwold was applied to to use his influence with the king respecting the foundation of St. Neot's in Huntingdonshire, which was begun by Earl Alric and his countess Ethelfleda. Ethelwold also consecrated the church and took it under his protection, sending monks from Ely and Thorney.

In 975 a charter was obtained for Winchester by the Bishop and subscribed by him, and shortly afterwards King Edgar died. During the reign of this prince Ethelwold also signed charters for Westminster, Rochester, Ramsey and York. Dunstan and Ethelwold immediately crowned Edward the Second, surnamed the Martyr, as King, but they soon found in the Queen Dowager Elfrida a powerful antagonist, bent upon their ruin. One of the results of these discussions was as before mentioned, the holding of the councils of Winchester and Calne, and the country was distracted both with civil and religious broils.—In 978 Elfrida proceeding to greater extremities, murdered the king, who was succeeded by Ethelred, surnamed the Unready. This prince was crowned on the Sunday fortnight after Easter, in 979, at Kingston, by Dunstan, Oswald, Ethelwold, and nine other prelates.

In 980 Ethelwold completed one of his great works, the cathedral of Winchester, which he rebuilt from the ground, obliging the monks themselves to assist with their own hands in the work. It is related that one of them named Guth, being at the top of a high scaffold at work fell down, but by the protecting influence of our saint, received no injury, climbing up again and resuming his labours, as if nothing had happened. In this year Ethelwold added to the cathedral the crypts or vaults under the east end of the church, and the walls, pillars, and groining of which remain in much the same state in which he left them, and are executed in a firm and bold, though simple and unadorned manner that gives no contemptible idea of Saxon art. A weather cock and organ are enumerated among his performances, and he enriched the church with the shrines of St. Swithin, Birin, Brinstan, St. Alfege and St. Edburg, when a farther rededication took place with great splendour, in the presence of King Ethelred, Archbishop Dunstan, and eight bishops. In 981 the Bishop of Winchester signed the charter for Tavistock, and ordained Elsy as Abbot of Ely.

It was in this year that the Danes attacked and plundered Southampton, and put Winchester itself in peril, and in the next year our prelate buried Alderman Ethelmer. In 983 Ethelwold visited Dunstan at Canterbury, and that saint foretold to him his approaching death. In 984 we find his last public act in his attestation to the charter of Shaftesbury, and in that year being taken ill at Beddington, in the county of Surrey, he died there on the 1st of August 984, his death being it is said accompanied with miraculous circumstances, his body having all the freshness of life, and his face the rosy hue of that of a young boy. His body was transported with great pomp to Winchester, and he was buried in the cathedral, but in what part is uncertain.

As an ecclesiastic Ethelwold has received the unbounded admiration of the monkish writers, but from every one his conduct during the famine at Winchester, leaving all other things out of consideration, entitles him to universal praise. During that severe famine he caused all the church plate to be sold in order to purchase provisions for the poor, remarking that the church, if reduced to poverty, might be again enriched, but that if the poor were starved, it was not in the power of man to recall them to life. His life is said to have been of a most hermit-like character, devoting himself to labour and study. Of his miracles besides those already alluded to, many are mentioned, particularly of the arms of a thievish monk being suddenly bound down to his side, of the Bishop's being found by the monk Theodoric overcome with fatigue, and sleeping over his book, how the monk sat down in the bishop's seat, was frightened by a horrible vision, and temporarily blinded for his temerity, how another monk Leofred, under similar circumstances, found that the candle had fallen on the book without even greasing it.

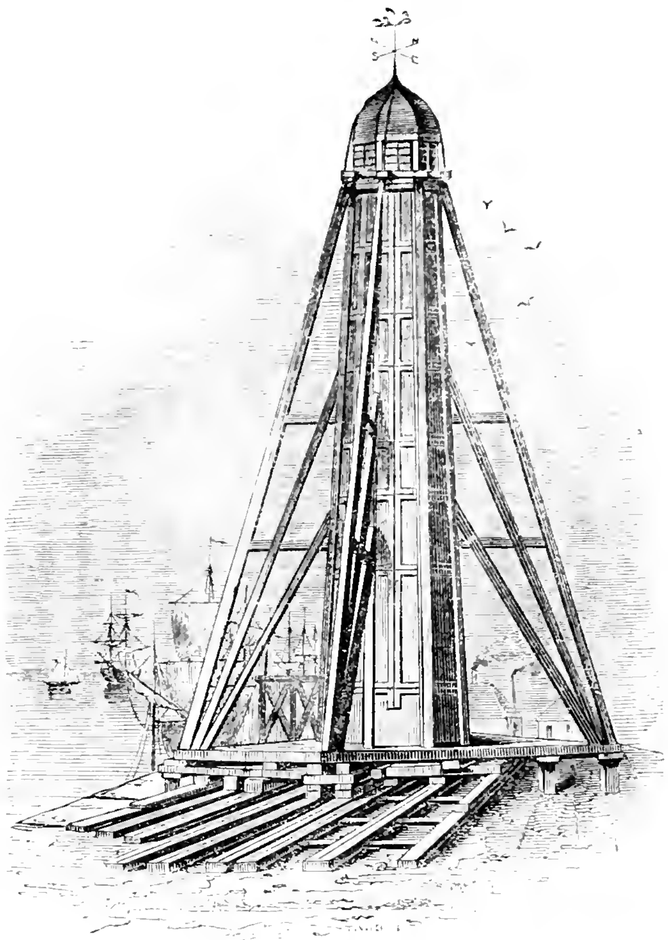
Ethelwold is represented as active in person, of acute genius, and of extremely retentive memory. We know that he patronized and practised every liberal art, and we have Alfric's testimony that he was one of the great restorers of learning in that age. Of his writings we have no specimen, except the prayer for the prosperity of Abingdon, but of his scholarship we can entertain no doubt, his zeal for the advancement of learning causing him throughout his life to teach personally, and he was consequently the instructor of many of the most distinguished characters of the age, both in civil and religious life. As an illuminator he is said to have had great skill, and his love for music showed itself in the foundation of the school at Abingdon. As an architect he is said, like his successor William of Wykeham, to have been a great builder both of churches and divers works, both while abbot and bishop, and we may note his mechanical skill in the donations he made to Abingdon. Besides the canal at Abingdon, he was also the designer of a similar work at Winchester, the benefit of which, says the historian of Winchester, is still felt by the inhabitants. They experiencing great inconveniences from the want of water, which then only flowed in one current at the eastern end of the city, St. Ethelwold made different canals, one of which begins near the village of Worthy, and thus distributed the water, at great toil and expense throughout the greater part of the city. He is also said to have been the builder of what is call St. Swithin's chapel at Winchester.

For a character so distinguished in all time the greatest admiration has been felt, and we have his life from the pens of two cotemporaries and pupils, Alfric, monk of Abingdon, and Wolstan, chanter of Winchester. It was in 996 that Alfhelm of Wallingford, being attacked with blindness, was directed by a vision to the tomb of Ethelwold and to Wolstan, who also had a vision of the saint, and on Christmas eve of that year, the body of the saint was enshrined. The offices in his honour are to be found in the Acta Sanctorum for the 1st of August, with two hymns in his honour, one of which is a curious specimen of the alliterative form adopted in Latin. The episcopal chair of this eminent man long remained an object of veneration and popular awe, it being believed that those, who, while they sat in it, instead of attending to the divine office, gave way to sloth and drowsiness, were punished with terrific sights and painful visions. A representation of St. Ethelwold is said to exist in the west window at Winchester.

[Authors consulted:—Wolstan's Life of St. Ethelwold; Acta Sanctorum: Acta Sanctorum, Ord. St. Benedict; Mabillon, Annales Ord. Sancti Benedicti; Butler's Lives of the Saints; Dugdale's Monasticon; Milner's Winchester: Britton's Winchester Cathedral; Warner's Hampshire; Lyson's Berkshire; Turner's Anglo Saxons; The Saxon Chronicle; Knight's Pictorial History of England; Penny Magazine, No. 503; Rudborne's History of Winchester in Wharton's Anglia Sacra; Life of St. Dunstan; Life of St. Oswald; Life of St. Edith; Life of St. Alfege the Elder.]

Ramsgate.—We understand that a survey is in progress for the purpose of ascertaining the practicability of a plan for forming a harbour of refuge capable of containing a fleet of men-of-war, or merchantmen of the largest class. It is well known that the Goodwin and Brake Sands afford considerable shelter to this part of the coast, and if the additional works necessary for forming this bay into a harbour of refuge can be made at a comparatively moderate expense, it will be one of the grandest and most valuable undertakings of these modern and wonder-working times. The survey is being made under the direction of Sir John Rennie, by Mr Hamilton H. Fulton.—*Kent Herald.*

SUNDERLAND LIGHT HOUSE.



In the Journal for September last, we gave a short account of an unusual occurrence, the removal of a Light-house, which we are happy now to announce has been firmly set upon its new foundation. The above engraving is a view of the light-house taken during its progress by Mr. Nicholson, of Newcastle. The removal from the North Pier was commenced on the 2nd August, and transplanted to the eastern extremity of the pier, a distance of 500 feet, and placed upon its new foundation on the 30th September last, and all the work will be completely finished by the 2nd instant, the whole period occupied being only two months.

The following is the plan submitted by Mr. Murray to the commissioners of the River Wear in May last, when it was under their consideration to pull down and re-erect the light-house on its new site:—"The masonry was to be cut through near its foundation, and whole timbers were to be inserted, one after another, through the building, and extending seven feet beyond it. Above and at right angles to them another tier of timber was to be inserted in like manner, so as to make the cradle or base a square of 20 feet; and this cradle was to be supported upon bearers, with about 250 wheels of six inches diameter, and was to traverse on six lines of railway to be laid on the new pier for that purpose. The shaft of the light-house was to be tied together with bands, and its eight sides supported with timber braces from the cradle upwards to the cornice. The cradle was to be drawn and pushed forward by powerful screws along the railway above mentioned, on the principle of Morton's patent slip for the repairing of vessels." The project was approved of, and the necessary arrangements made for carrying it into effect; the only deviation from its plan being, that during the progress of the work a windlass and ropes, worked by 30 men, were substituted for the screws. Not a crack nor appearance of settlement is to be found in the building.

We have been favoured with the following communication from Mr. Murray, by which it will be seen that the under-setting of the foundations are perfected.

SIR—In reply to your communication respecting the removal of the light-house on the north side of the harbour, I have to state that since it has been brought to its new site I have drawn out the timbers upon which it was conveyed, and the base on its southern side has been underset with two pillars of solid masonry. I am proceeding to do the same on its northern side preparatory to striking the supporting braces of timber, which probably may occupy another fortnight.

The light-house was erected in the year 1803, by the late Mr. Pickernell, then engineer to the harbour commissioners. It is wholly composed of stone; its form is octagonal, 15 feet in breadth across its base, 62 feet in height from the surface of the pier to the top of the cornice, where it is 9 feet in breadth across, and the top of the dome is 16 feet above the cornice, making a total height of 78 feet; and its calculated weight including the cradle and supporting timbers is 320 tons.

I am, Sir, your obedient servant,

JOHN MURRAY.

Sunderland, October 18, 1841.

It affords us much pleasure in offering our congratulations, with which we are sure all the profession will join, to Mr. Murray for the very successful issue of the bold experiment.

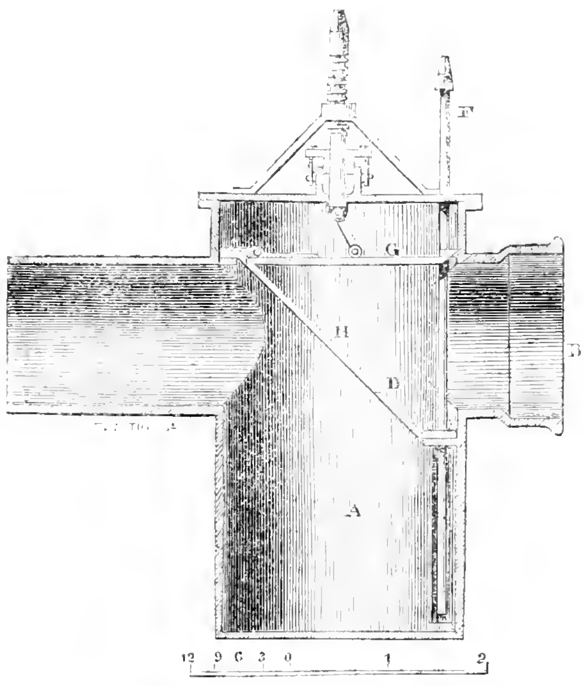
NEW SYPHON GAS VALVES.

SIR—I beg to forward you herewith a drawing with description of two Syphon-valves for the use of Gas Companies, which I have intended to answer the double purpose of syphon (or receiver) and regulating valve, and I flatter myself I have succeeded in my object. The cost of either valve and syphon united, will be considerably less than the common slide valve alone. Knowing it to be a subject of interest to many of the readers of your highly esteemed Journal, I have for some time had this subject under consideration, and I now place the result in your hands, by an early insertion of which you will oblige.

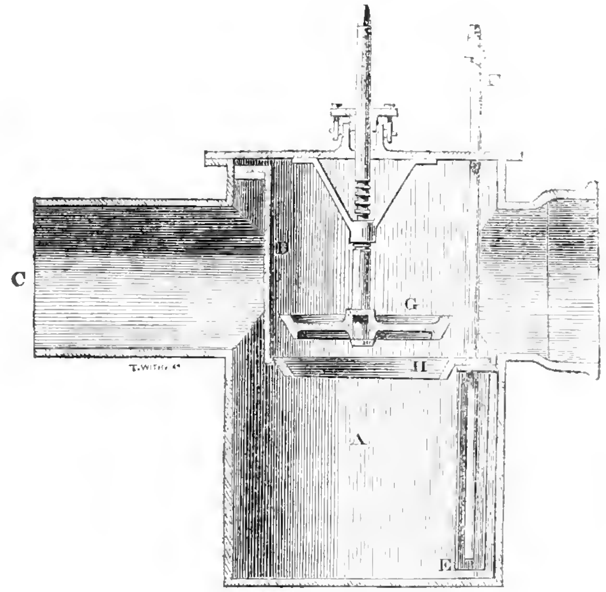
Sir, your very obedient servant,

THOS. HENRY NIMMO.

Chartered Gas Company,
Westminster Station,



A, cylinder to receive condensation, &c. from mains.
B, the inlet to be jointed into spigot of pipe.
C, the outlet to be jointed into socket of pipe.
D, division plate directing the inlet from the outlet, and bolted to the cylinder.
E, the tube to convey condensation, &c. from main into cylinder.
F, is a smaller tube placed within E, through which this condensation is drawn off.
G, the valve.
H, the valve-seat.



NOTE.—The supply of gas will be regulated in the same manner as other valves.

October 15, 1841.

IMPROVED RAIL AND CHAIR FOR RAILWAYS.

SIR—Having been practically engaged in the construction of railways for some years, my attention, about three years since, was directed to the designing a rail that should overcome several of the disadvantages, if not failures of the then, as well as the one still used, of intermediately supported rails.

My observations were then, and are now, with regard to that description of rails at present used. *First*, that the greatest strength of the rails is not in the direction of the force which they are intended to bear.

Secondly, that there is invariably considerable attrition between the rail and chair, and between the joints of the rails, and from which a portion of the useless noise so much complained of on Railways arises.

Thirdly, the fixing of the rails is subject to failure, by the loosening of the key or wedge that is used to fix them in the chair from the attrition consequent upon the imperfect connection between two hard surfaces, or from the wooden wedge having greater force to sustain than it is able without being compressed.

Fourthly, from the great force required to roll the irregular forms of the present rails, the same are very frequently flawed or fractured by the force applied to change the metal to the form so widely different from the bar converted, or otherwise in cooling from the sudden difference in bulk of metal after the rails are rolled.

From the preceding observations I designed, and have practically proved the following rail, which I shall feel grateful for the indulgence of making it public through the medium of your valuable and widely-circulated Journal. I respectfully submit it to the consideration of the profession, that it claims the following advantages.—First, the equal strength to resist or bear the weight or force of the transit of carriages with one-tenth less metal than intermediately supported rails now in use.

Secondly, requiring less power to roll the metal, and there being much less possibility of the rails being fractured by the process of rolling.

Thirdly, the greater security in fixing the rails in the supports, particularly at the joints.

Fourthly, the simplicity and strength of the supports added to the security of the rail, lessening the attrition, and being constructed with as little or less metal than the supports generally used. It will be admitted according to theory and practice, by a perfect cylinder rolling on a perfectly horizontal plane, the weight of the cylinder is received in vertical pressure on the surface of the plane. But as the wheels used on railways are not portions of cylinders but are portions or frustra of two cones with their bases opposite, formed by an axle (whose centre is the axis of the cones) at the distance of the gauge of the rails; although the surface of the rails should be perfect planes, the pressure or weight and force of the vehicles, and their contents transmitted from the surface of the wheels on to the rails, will not be vertical but at right angles to the head or surface of the wheels (which are portions of two cones), consequently the resistance to the force from the wheels ought to be in the direction the force is received from the surface of the wheels, and the strength and support for the wheels of railway carriages ought to be laterally as well as vertically. In the common intermediately supported rail, this is endeavoured to be obtained laterally by the flange of the rail, and vertically by the depth of the rail, assisted a little by placing the chairs declining a little inwards, but which is entirely at the mercy of the workmen employed to lay the rails.

Fig. 1.

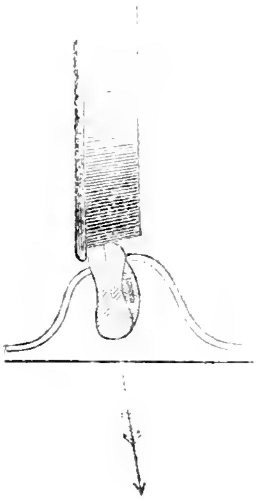


Fig 2

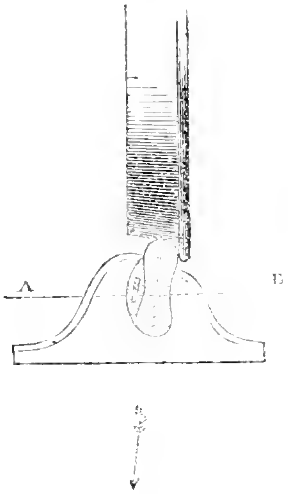


Fig. 3.

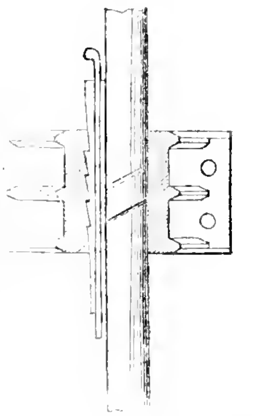
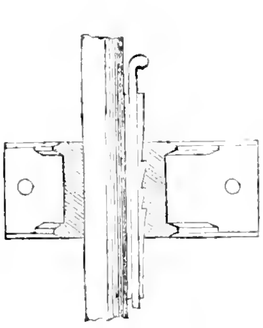


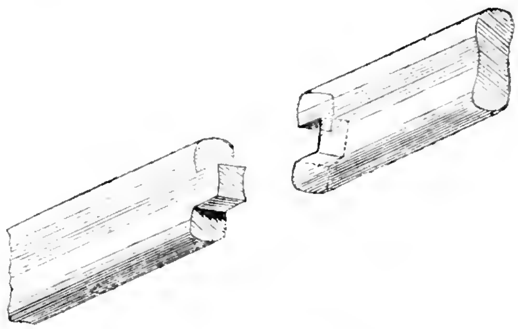
Fig. 4



From the preceding axioms, I will endeavour to show, that my design is practically on the right principle for intermediately supported rails, in as clear and concise a manner as I possibly can, by reference to the diagrams.

Figs. 1, and 2, are elevations of two chairs, with portions of wheels thereon, and section of rails. Figs. 3, and 4, are two chairs cut off at the line A B in fig. 1, shewing the juncture of two rails in the wide chair, fig. 3. Fig, 5, is a perspective elevation of the rail, shewing the tongue joint. Figs. 6, and 7, are diagrams of two barrels, the railway wheels are supposed to be portions thereof. The one fig. 6, is supported by two half-inch boards four inches wide, placed at right angles to the bearing surface of the barrels. The other, fig. 7, sup-

Fig. 5.



ported by one-tenth more wood in the shape and position of the common rail: this is suggested as a cheap and easy practical experiment to test the principle of the rail.

Fig. 6.

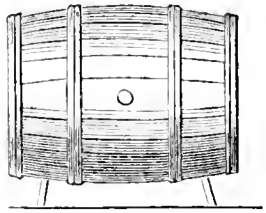
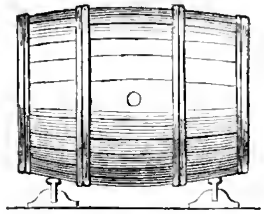


Fig. 7.



With regard to the rail being equal in strength with one-tenth less metal, arises from its being placed so as to receive the direction of the force or weight from the surface of the wheels in the direction of the greatest strength of the rail, and from its impracticability to bend outwards without rising upwards, so long as the weight or force is not more than the rail will bear without flexure, and the tendency of the wheels to thrust outwards, will of course prevent its bending inwards. In the rolling metal in the several forms they are now used on railways, the force or power required is in the proportion of the several angles that are to be formed, and the departure of the form from the previous section of the metal, and the forming of internal angles, is not only the cause of the rails being fractured by the greater force required for internal angles, but from the sudden difference in bulk of metal on its cooling, consequently a rail that has no internal angles, and the form, but the slightest departure from the section of the metal converted will require less power or force to roll it, and there will be less liability to fracture.

The security of fixing the rail in the chair consists in avoiding the attrition of two hard surfaces of equal density, by introducing a piece of metal more malleable than the rail or chair between them, and by securing the rail with a wood wedge, prevented from coming out by means of an iron key being driven into the centre of it, causing the wood to fill the ratchets in the chair as shown in figs. 3 & 4, and the wood having the greatest pressure downwards on the rails, as shewn in figs. 1 and 2, keeps the rail securely from rising, and the wood receives but little or no pressure from any weight transmitted from the surface of the wheels as shewn in figs. 1 and 2, and is therefore not liable to failure. The security at the juncture of two rails consists in their being kept firmly down in the chairs by the manner of their jointure by a tongue joint, as shown in fig. 5, are prevented from rising one above the other, and the noise is prevented by introducing a piece of thin cast lead between the meeting of the two rails, and by the chair being made of greater width as shewn in fig. 3. The chairs are without any internal angles, and consequently are not weakened, nor do they require additional metal to counterpoise against it, and their being no outward pressure by the rail, the chair does not require to be cast so heavy as those used to resist the outward pressure of the vertical rail. In conclusion, on this design I have only to add, I have full sized models of the above rail and chairs, and should it meet with the approval of the profession, I shall be happy to undertake the laying of the permanent way on any line of railway.

And am, Sir,
With much respect,
Your obedient servant,
W. B.

PROPOSED IMPROVEMENTS IN RAILWAY CARRIAGES FOR THE PREVENTION OF ACCIDENTS

Sir—In conversation with a friend on the late Brighton Railway accident, I have been informed, and believe the fact is, that from the generality of accidents on railways affecting the passengers on the first carriage behind the tender, (the engineer or engineers lives being considered of little value) a luggage van is placed behind the tender, or between the tender and first passenger-carriage, and the company do it as a great preventive of danger to the lives of the passengers, and as to the engineers, it is better for them to be in danger of their lives to make them vigilent and careful; all this may be very good for railway companies to soothe the public, but it can never be necessary to make engine-men careful by placing their lives in jeopardy beyond what can be absolutely avoided or eased, and I most respectfully submit it to the public, that as the engineers in the tender, and passengers in the first carriage behind the tender are subject to greater risk of their lives than the passengers in the second carriage behind the tender, and those at greater risk than the passengers in the third carriage and so on, the risk decreasing in the ratio to the distance of the carriage from the engine, the cause ought to be solved, or at least an attempt made to render the tender safer, and the first carriage as safe as the fifth one is now, and not let it rest by placing even a luggage van, to say nothing of passengers luggage in the van, in a situation of such imminent risk.

As a strenuous advocate for rendering travelling by railway the *ne plus ultra* for safety, I propose for consideration a few suggestions for the prevention of accidents on the following grounds.

The carriages are now all provided with elastic concussion receivers of equal elasticity, although it must be quite evident the elasticity is not acted on equally. To illustrate this we will suppose the elasticity of each carriage equals 1, and all the carriages are close on their concussion receivers; and we will suppose each elastic receiver to have already given way a length equal to one foot.

A train of carriages are started down an inclined plane, and at their arriving at their maximum velocity, an obstruction is met with, and the engine is stopped; the result will be that the tender comes with a force that the elasticity of 1 in 1 foot is completely overcome, and a concussion is the result between the tender and the engine to such an extent as to throw the men off or out of the tender, and the tender being stopped, the first carriage adjoining thereto receives a concussion on it, although the elasticity between the tender and engine had allowed the same to be eased one foot, and consequently with the elasticity between the first carriage and the tender of 1 in one foot, the first carriage is eased by the elasticity of one in two feet, but this proves to be insufficient and so does the elasticity or the easing received by the second carriage which is equal to 1 in 3 feet, but the elasticity received by the third carriage, proves in some cases sufficient to overcome to a very great extent, the concussion caused by the obstruction met with. As an improvement, I propose that the elasticity between the engine and tender should be increased to the greatest extent possible, say five feet, and the receivers of the concussions be kept close to each other, that is the drawboys or connecting chains should be just long enough to keep the receivers close, this would give the luggage van behind the tender, the safety the sixth carriage, and the first passenger-carriage the safety, the seventh one now enjoys. Trusting my motive in forwarding the preceding remarks, being for the safety of railway travelling, will be a sufficient plea for requesting it a place in your columns.

I am, Sir,
Your very obedient servant.
W. B.

ANONYMOUS ARCHITECTS.

Sir—I should feel obliged to any of your correspondents who would supply some information relative to the Market Cross at Shepton Mallet, which I understand is a new structure, and a handsome one of its kind. I could further wish to ascertain who was the architect of the building occupied by the "Society of Arts," at Birmingham, his name not being mentioned in Drake's "Picture" of that town, although the structure itself is there spoken of as "one of the most striking edifices" in the whole place. Surely local "Guides" might afford some information as to the authorship of modern buildings—which could be ascertained on the spot without any very great difficulty; or are we to suppose that the public have not the slightest curiosity whatever as to such trivial matters, and care no more who was the architect that designed, than who were the masons and labourers employed upon a public edifice.

In the case of a paltry building, the concealment of the architect's name may be an act of great kindness towards him; but it is somewhat preposterous to speak of one as "a splendid edifice"—"a truly elegant piece of architecture;" or in other terms of very high praise, and yet treat the author of the design as if he were a mere nobody, whose name was not worth recording at all,—not so much as that of an organ builder, for artists of the last description come in far more frequently for some share of notice.

Such being the case, it becomes a question whether its architect's name ought not invariably to be inscribed on every building making any pretensions to design;—I do not mean that it should be conspicuously placed so as to attract notice, but inscribed quite unobtrusively somewhere on the level of the eye, where if sought it could at once be found out,—in fact just as the name of an artist is attached at the bottom of an engraving; and if no objection be made to this last practice as savouring of presumption or conceit, hardly could there be any scruple as to adopting a similar practice in regard to buildings. In some few instances it might be altogether superfluous,—for example in the New Houses of Parliament, and the Royal Exchange, it being already matter of notoriety throughout the kingdom, that Barry is the architect of the one, and Tite of the other. But there are many works —and those not without merit, of which owing to there being no architect's name attached to the structures themselves, it is very difficult to ascertain by whom they were designed. However should I be mistaken at least in regard to the two above-mentioned—the information I ask for, can be furnished me in your next number.

I remain, &c.
Z.

DREDGE'S SUSPENSION BRIDGE.

Sir—I have been accidentally prevented from seeing your Journal of September last until now, or I should sooner have availed myself of your kind permission to reply to Mr. Dredge's communication. I do not know whether it is a part of Mr. Dredge's *patent right* to be exempt from criticism, but if such be the case, it ought in fairness to have been announced to the public at the same time that the invention was made known; as this, however, has never, I believe, been done, it is hard to account for the expression of "injured innocence" with which Mr. D. has seasoned his letter, unless, indeed, he is to be regarded as a sort of privileged character, whose inventions are not to be subject to animadversion like those of other individuals. Neither was I before aware that the truth of a mathematical demonstration was, in any degree dependent upon the name of its author, but as Mr. D. seems to think otherwise, I now give my name, in order that he may no longer suffer from the intellectual trammels which it would seem I have most unwittingly imposed upon him. It is much to be wished that Mr. Dredge, at the same time that he made known my having misconceived the construction of his bridge, had, at least for the benefit of your readers, if not of myself (who it appears am undeserving of such a favour, because I have omitted my name) stated in distinct terms, what are the peculiar features which distinguish his patent bridge. I should thus have been enabled to form an opinion of the merits or demerits which it may possess, without incurring the danger of a second "great mistake;" but as the case now stands, I do not see how I can enter upon the discussion with justice to myself or your readers, as it might very possibly happen that I should not be writing about Mr. D.'s bridge, but something quite different. The drawings which appeared in your Journal (Vol. III. page 193), it must I think be allowed, are calculated to convey the impression that the suspension rods are arranged in parallel though inclined positions, especially Fig. 3, at least they do not appear to be *tangents* to the curve which Mr. D. *seems* to assert, and no one could suppose, of course, that they are arranged without any order or method whatever. I think, therefore, that the inspection of the drawings alluded to, would necessarily lead to the conclusion that the rods were parallel. If, however, I have fallen into an error upon this point, which, however, Mr. D. does not distinctly assert, it will follow that such of my remarks as are founded on the supposition of the rods being parallel, will immediately fall to the ground as inapplicable to Mr. D.'s bridge, and I am quite willing to allow him the full benefit of this, claiming, however, at the same time for myself, the privilege of examining his bridge *de novo*, when I know what it is; and he may rest assured that should I discover any merits which were not before apparent, I shall at once freely acknowledge them.

I remain, Sir,
October 11. Your obedient servant,
George F. Fordham.

ON THE FORMS AND PROPORTIONS OF STEAM-VESSELS.

Sir—A former paper on this subject, which you were so good as to give a place in your columns, having occasioned the observations of your correspondent A. M., before proceeding further, his letter demands my attention. I think his objections to the method adopted for ascertaining the comparative resistance of the simple forms of vessels on which the calculations were founded, arises principally from his having overlooked the effect of what has commonly been called the "minus pressure," that is, the loss of pressure abaft, occasioned by the water's not closing in immediately on the vessels' after body, on account of the rapidity of her motion. This effect of motion is equivalent to an increase of pressure on the bow, and when the velocity is such that the water will not close in on the *lowest* part of the immersed body, the case becomes one of simple hydraulic pressure increased by motion. Besides the loss of pressure occasioned by the absolute absence of water behind the moving body, it has always been found that there is a great reduction in this respect before such a velocity has been attained as would prevent the closing of the water behind. This is occasioned by the *rarefaction* of the water, or its being mixed with a large portion of air, or leaving intervals of unoccupied space in the wake of the vessel, and though these effects are of course diminished, (as it was my intention to notice as I proceeded with the subject) by the proper modification of form in the after body of a vessel, I believe that in the simple forms which I have supposed, moving at such velocities as are acquired by large steamers at the present day, the result of these two sources of resistance would be such, that the sections would rest very nearly on the merits of their respective hydraulic pressures. It is the difficulty of estimating the exact influence of these two effects, which has caused all experiments hitherto made, as far as I can ascertain, to prove defective in their results, and apparently to contradict themselves at different velocities. Sir Isaac Newton assigned twice the pressure given by M. Bomit, and though he shewed his own results to be defective, they long remained the best data on which calculations on this subject could be founded. The experiments of the London Society for the Improvement of Naval Architecture, did not afford the means of establishing any certain law for estimating these resistances, and the velocities at which their trials were made being comparatively low, I do not think I am altogether unauthorised in adopting this mode of calculation for high velocities and simple forms. Some experiments detailed by Dr. Hutton, on the motion of bodies in air tend to support this view, as they show that resistance increases in a larger ratio than the square of the velocity even in an elastic fluid, and the deviation from this ratio becomes greater and greater as the velocities are increased, a result most probably arising by decrease of pressure on the hinder part of the body, caused by the rarefaction of the air as the speed is increased.

After this explanation, I proceed briefly to notice the two points of carriage of fuel, and action of the paddles as compared in vessels of the different proportions supposed. If two such vessels required each 400 tons of coal for her voyage, equal to about 16,000 cubic feet of water, the vessel 200 feet long by 40 beam, would have her draught of water increased 2 feet by this additional load, while the other, 200 feet by 30, would suffer an increase of draught of 2 ft. 8 in. We here see that the narrower vessel has the disadvantage in several respects, she has a greater depth in proportion of her body immersed, and suffers consequently an increase of hydraulic pressure. In consequence of the coal occupying a greater depth, on account of her smaller amount of beam, than in the other vessel, her centre of gravity is more raised in proportion, brought nearer to her axis of rotation, if it was before below it, and raised further above it, if in the first instance it was already so, as I believe most frequently is the case. In either case one great source, though perhaps not the principal one, of her stability or power of resisting a rolling motion is diminished; she is rendered less able to carry sail, which may sometimes prove the only resource for safety and less able to resist the stroke of the sea abeam, the latter being very commonly supposed among nautical men to be the cause of the President's foundering. Again, by leaving a smaller depth of the hull vacant for buoyancy above water, her power to rise over a sea is diminished, and she will consequently be wetter and pitch deeper in proportion to her increased load than the wider vessel. And lastly, (supposing her a vessel of the usual form) by bringing her full lines more in contact with the water, her speed must suffer a most serious diminution. Again, as regards the action of the paddle-wheels, supposing the paddles of these two vessels to be of equal diameter, and the floats having the same dip at their respective draughts of 15 and 20 feet. The narrow vessel again suffers a disadvantage as compared with the other; for her paddles being sunk deeper, the floats enter the water at a smaller angle to the horizon, and leave it at a greater, and thus the effective action is diminished and the backwater increased. This defect being severely felt in narrow vessels, different means have been tried to counteract it. The mean dip of the paddles has been reduced by raising the wheels higher on the hull, but this method has the disadvantage of making the paddles fly light when the fuel is reduced, the weather wheel frequently hardly dipping; the heavy pedestals for the paddle shaft must also be raised with it, and thus the centre of gravity must also rise, and the tendency to roll be increased, and if the hull be built higher out of the water in the same proportion, an unnecessarily large surface is exposed to the sideway action of the water and wind, and the rolling tendency still further augmented;—besides the engines working more rapidly increase the consumption of fuel without a proportionate increase of speed. The various descriptions of feathering paddles seem most applicable to narrow deep vessels, as it is in such when deeply laden that the oblique action of the floats is most felt; but even here I believe the additional power requisite to overcome their friction is generally considered to counterbalance the gain of power; and the floats being all constantly vertical present a much larger surface to the direct action of a head or following sea, and in such case become additional impediments to speed. The reefing paddle seems most likely to answer the end proposed, but may it not be a question whether the increased speed of the engines, when the wheels are reduced in diameter, does not cause some increase in the consumption of fuel? which would certainly be avoided in a great measure by building vessels of such proportions as would render any such contrivances needless. Feeling the great advantage of experimental evidence in support of expressed opinions, it was my intention to have illustrated these remarks by a few simple experiments, bearing solely on the points they refer to, but on consideration, so many difficulties appeared to oppose the probability of obtaining any data sufficiently accurate by such means as I could command, that this design was unavoidably abandoned. It is to be hoped that the experiments now proceeding under the auspices of the British Association, of the further prosecution of which I was not aware when I entered on this topic, will tend to clear away the difficulties which have hitherto attended the application of theory to this interesting subject, and advance naval architecture to a station somewhat more on a parallel with the present state of the other practical sciences.

I am, Sir, your's, &c.

H. P. H.

COUNT DE PAMBOUR IN REPLY TO MR. PARKES.

Sir—In a paper written by me and inserted in your number for September last: *On the Momentum proposed by Mr. Josiah Parkes, as a measure of the mechanical effect of locomotive engines*, the following passage occurs: "The author tells us that he is more accustomed to handle the hammer than the pen." I have since perceived that I had, there, by mistake, attributed to the paper of Mr. Parkes, *on boilers and steam engines*, a sentence which I had read in the very useful work of Mr. Armstrong, *on the boilers of steam engines*, preface, page xi, Weale, 1839. The two works having come to me at the same time, and being precisely on the same subject, I had made the error of ascribing to the one, what in reality belongs to the other. This point is however without the least importance, having no reference to the arguments presented in my paper, and I correct it only for the sake of accuracy.

Since the publication of the paper above alluded to, Mr. Parkes has printed in several periodicals, a letter in which he accuses me of having misrepresented his sentiments, in my refutation of his strictures against me. I had thought, first, that if my paper itself were put under the eyes of the persons who had read Mr. Parkes's letter, it would, by the full references contained in it, show sufficiently that I had not misrepresented the sentiments of Mr. Parkes; and I had, in consequence, only asked of the editors of the periodicals in which Mr. Parkes's letter had been published, to insert that paper as an answer. But this request having been refused by the *Literary Gazette*, and a mutilated part only of the letter which I had sent with the paper, having appeared in the *Mining Journal*, with the omission of what I considered the most important passages, it becomes necessary for me to make a different answer. Therefore, I beg you to insert in your next publication, the following paper, as a reply to Mr. Parkes's allegations.

I remain, Sir,

Your very obedient servant,

G. De Pambour.

October 18, 1841.

Supplementary paper, *On the Momentum proposed by Mr. Josiah Parkes, as a measure of the Mechanical effect of Locomotive engines.* By the Count de Pambour.

In a former paper, inserted in the Civil Engineer and Architect's Journal, for September last, we have proved that all the strictures presented by Mr. Parkes, in his paper: *On steam boilers and steam engines*, inserted in the *Transactions of the Institution of Civil Engineers*, vol. iii., against some of the experiments of our *Treatise on Locomotive Engines*, are entirely founded upon errors of his own; and, besides, that his *momentum* or intended "standard" of the mechanical effect of locomotive engines, which he proposes to substitute in place of every other research on the same subject, leads him to conclusions and results altogether faulty.

However, as in a letter inserted by Mr. Parkes in several periodicals (*Literary Gazette*, September 18th, *Mining Journal*, same date, *Civil Engineer and Architect's Journal* for October), he complains that in answering his strictures, we have misrepresented his sentiments, we shall now add a few more observations, to show that we have not misrepresented the sentiments of Mr. Parkes; and, besides, that it is not upon sentiments, but upon facts, that we can establish clearly *that the whole of the calculations and tables of Mr. Parkes are erroneous*, and, as every one of his conclusions and strictures are founded upon the numbers obtained in his tables, *that every one of his conclusions and strictures are equally erroneous.*

For that purpose we shall resume, in the same order, all the articles of our former paper, quoting more particularly the facts, or the expressions of Mr. Parkes, upon which is grounded our refutation.

1st. We have said that, to calculate the mean pressure of the steam in the cylinder of each of the engines submitted by us to experiment, Mr. Parkes uses the *average* velocity of the whole trip between Liverpool and Manchester. This fact cannot be denied, and is made quite evident by looking at his table viii. column 10, table xiii. col. 9, table xvi. col. 2, in which the velocities are headed, *mean velocity of the engines per hour*, and are in fact the average velocities of our experiments, given page 175 of the *Treatise on Locomotive Engines*, 1st edition, and page 253, 2nd edition; with the exception only of the cases in which Mr. Parkes has increased the velocities, from a pretended correction of his own, of which we shall speak in a moment.

Now, in recurring to our former paper, same article, it will be seen that such mode of calculating the pressure in the cylinder, from the *average* or *mean* velocity of the whole trip, is altogether faulty: because it gives only the pressure which would have taken place, if the whole trip had been performed at a *uniform* velocity. But the velocity varied considerably in the different portions of the trip, according to the more or less inclination of the part of road traversed by the engine, as may be seen in our detailed table of those experiments (pages 225 to 234, 1st edition, and pages 389 to 394, 2nd edition of the *Treatise on Locomotive Engines*). And in taking account, *as ought to be done*, of the time during which each partial velocity has been continued, we have proved, in our former paper, that the *real* mean pressure in the cylinder, is very different from the pressure given in Mr. Parkes's calculation. We can, therefore, safely conclude that the pressures, and correspondent volumes, of the steam in the cylinder, presented by Mr. Parkes as the results of his computation, are altogether faulty.

2nd. We have shown a first error, which Mr. Parkes introduces, as a fundamental basis, in all his calculations, and which has nothing to do with his *sentiments*. But he does not stop there. We have said that, moreover, he increases almost all the velocities nearly $\frac{1}{6}$; and to be assured of this, it again suffices to compare, in his paper, table viii. col. 10, table xiii. col. 9, table xvi. col. 2, with our own table page 175, 1st edition, and page 253, 2nd edition, of the *Treatise on Locomotive Engines*. It will be found that the velocity of *Vulcan*, in experiment VI. (table viii. of Mr. Parkes), is increased from 22·99 to 26·90 miles per hour, that of *Vesta*, in experiment V, from 27·23 to 31·60 miles per hour, that of *Atlas*, in experiment III, from 15·53 to 18·15 miles per hour, that of *Atlas* in experiment IV. from 20·59 to 24·07 miles per hour, that of *Leeds*, in experiment VIII, from 21·99 to 26·70 miles per hour, that of *Fury*, in experiment IX, from 18·63 to 21·79 miles per hour, and that of *Fury*, in experiment X, from 21·99 to 23·00 miles per hour. So that, out of ten experiments extracted from our work, seven have been made entirely false by this alleged correction to the *observed* velocities; and this is worse than if the whole of them had been falsified in the same manner, as it would, at least, have left the same proportion between the results. Mr. Parkes makes the same addition to the *observed* velocities, and therefore introduces the same error, in calculating the experiments of Mr. E. Woods, with the *Hecla*, since we find (page 112):

"Mean velocity during the trip...... 29·47 miles per hour.
"*Difference for gradients* .... 1·46 „

"Mean velocity on a level .... 30·93.

Mr. Parkes falls into this error, because, in speaking of *fuel*, it is said, in our *Treatise on Locomotive Engines* (page 324, 1st edition, and page 311, 2nd edition), that when the engines ascend without help one of the two inclined planes of the Liverpool and Manchester Railway, the surplus of work, thence resulting for them, equals, on an average, the conveying of their load to about $\frac{1}{6}$ more distance; that is to say that the engine will, in that case, consume as much *fuel* as if it had conveyed an equal load to a distance greater by $\frac{1}{6}$, on a level. And the *critic* thence logically concludes (page 86) that the *velocity* must be by so much increased, without perceiving that this correction refers only to the *work* done, and, as a consequence, to the corresponding consumption of fuel, but not to the *velocity*, which would suppose, not only that the load has been conveyed to $\frac{1}{6}$ more distance, but, besides, that it has been conveyed there *in the same time*.

Respecting this mistake, we have also proved that the error of Mr. Parkes has the double consequence of increasing the pretended effect produced, and lowering the pretended pressure of the steam in the cylinder; so that the proportion between the power applied and the effect produced is made doubly erroneous, and introduced so in his tables.

All this is certainly undeniable, and rests upon tables and facts only, not upon sentiments, and when we say that the *whole* of the calculations and tables of Mr. Parkes are grounded upon those mistakes, it cannot be denied either, in looking only at table viii. col. 10, table ix. col. 19, table xiii. col. 9, table xiv. col. 3, table xvi. col. 2. It will be there seen that *every other column is depending upon the alleged velocity of the engines.* Therefore, we are right when we conclude that the volume and pressure of the steam consumed by the engines (table ix. col. 26, 29), the horse power produced per cubic foot of water vaporized, or the quantity of water and coke employed to produce one horse power (table x. col. 44, 45, 49, &c.), the *momenta* generated per second (table xiii. col. 11, 12, table xiv. col. 9, 10, 11), and finally all the consequences derived from the comparison of the results obtained in those tables, about the alleged inaccuracy of the experiments, or the respective effects of locomotive and fixed engines, are in every way erroneous.

To show, by a particular example, the fallacy of the results to which Mr. Parkes has been led by this wholesale and faulty way of calculating, with a wrongly averaged and greatly exaggerated velocity, without taking account of the gravity, or of any of the other resistances really encountered by the engines, we refer to the two experiments of *Fury*, of which Mr. Parkes says (page 128), "a reference to the *Fury* (previously adverted to as giving anomalous results) exhibits that engine as having performed more work at 23 than at 21$\frac{3}{4}$ miles per hour, by the ratio of 24 to 19; it is therefore with certainty we may conclude one or both of those experiments to be erroneous." We have shown that this consequence presented by the *critic* with such certainty, proceeds only from his having neglected to consider that one of the experiments was made from Manchester to Liverpool, and the other, on the contrary, from Liverpool to Manchester. But, on account of the general rising of the road from Manchester towards Liverpool, the gravity opposes more resistance in that direction than in the other. So that, although the load of the engine was lighter in the first trip, still there was more work required of the engine, to convey that load to the other end of the line. In fact, in making the calculation as it ought to be, that is to say in taking account of the gravity *overlooked by Mr. Parkes*, it is found that, in the trip made from Manchester to Liverpool, the work done by the engine amounted to conveying 1964 tons to one mile, or 65·5 tons to 30 miles, on a level, and in the other trip, to 1837 tons to one mile, or 60·6 tons to 30 miles, on a level. Therefore the engine ought to have employed more time in performing the first trip than the second, which, concurrently with the other errors of computation of Mr. Parkes, had led him to conclude with "certainty" these experiments to be erroneous.

3rd. Mr. Parkes (pages 82, 83) says, "the pressure deduced from the sum of the resistances, given in column 29, for M. de Pambour's experiments I. to X, is composed, 1st of the friction of the engine without load, which includes the resistance opposed to it as a carriage, in common with the train; 2ndly, of the additional friction brought upon the engine by the load; 3rdly, of the resistance of the load at 8 lb. per ton. According to the author, these three items include all the resistance overcome by the steam, excepting that occasioned by the blast, in excess over the atmosphere. The amount of the latter should, therefore, be ascertainable by comparing the whole force exerted by the steam on the piston, with the force assigned as requisite to overcome the aforesaid three, out of the four component parts of the total resistance. The difference between these pressures should represent the precise amount of the counter elasticity of the steam in the blast-pipe." So, it is clear, as we have said in our former paper, that Mr. Parkes calculates the pressure owing to the blast-pipe, merely by taking the difference between the valuation of the divers resistances and *his own* result of the pressure of the steam in the cylinder. Now, we have already proved that this last result, obtained by Mr. Parkes as representing the pressure in the cylinder, is altogether erroneous. Therefore his supputation of the pressure in the blast-pipe must equally be so. But, besides, it is evident that such a mode of proceeding, by merely taking the difference between two assumed quantities, to establish the value of a third unknown, could never give, for this one, a value sufficiently certain to make it the test of experiments and *facts*; since every thing neglected in the calculation, like water lost by *priming*, resistance of the air, gravity, &c. would necessarily pass to the account of the pressure due to the blast-pipe, and falsify it. Consequently, if, by this calculation, Mr. Parkes is led to very inaccurate results, he ought not to be astonished, and we are not certainly.

4th. Mr. Parkes (pages 98, 99), in speaking of our two experiments made with the engine *Leeds*, says: "the author also has informed us that in the two experiments, the pressure in the boiler was precisely the same, and the regulator opened to the same degree. The power applied in the two cases was, consequently, precisely equal, and equal weights of water as steam passed through the cylinders in equal times; whence it results that the effects should have been similar. The expenditure of power was, however, greater by more than a third in the second than in the first case, to produce like effects, for we see that the effective horse power required 85·43 lb. of water as steam in the second and only 60·94 lb. in the first." And (page 100), "if, as asserted, the pressure in the boiler were precisely the same, and the regulator opened to the same degree in the second as in the first experiment, equal power must have been generated and expended in the same time, though at the higher velocity, the lighter load was moved through a greater space in that time. Had M. de Pambour reduced his data to the terms of value in these tables, he must inevitably have discovered the numerous errors of fact, and deduction, which are now brought to light."

So, it is clear that we did not misrepresent the sentiments of Mr. Parkes when, in our former paper, we said that he concluded against the accuracy of the experiments, because in the two cases cited, the useful effects of the engine had not been the same. But we have proved, in that paper, that in spite of an equality of pressure in the boiler and of opening of the regulator, there is always more loss supported by the engine, in overcoming its friction, the resistance of the air, &c., at a great than at a small velocity. Therefore, the useful effect produced, or *effective horse power* ought not to be *similar* in the two cases; and the "numerous errors of fact, and deduction, which are now brought to light," by the *Critic* and his tables, are nothing but a new misconception.

5th. We have said that Mr. Parkes submits the two same experiments, and the other experiments afterwards, to the test of a new principle, which consists merely in his making a confusion between the vaporizations effected in traversing the same distance and the vaporizations effected during the same time. This will be proved by the following passage, in which it will be seen that Mr. Parkes quotes our words relative to the vaporization *for the same distance*, and afterwards applies them to the vaporization *in the same time.* We have marked in *italics* the words which make this misreasoning quite evident. He says (page 99), "in his *Treatise on Locomotive Engines*, (pages 310, 312), M. de Pambour states a near parallel to these two experiments, by supposing a case of the same engine, with the same pressure in the boiler, travelling *the same distance* with two different loads. *The distance travelled being the same*, the number of turns of the wheel, and consequently of strokes of the piston, or cylinders of steam expended will be the same in the two cases.... So the mass or weight of steam expended will be in each case in the ratio of the pressure in the cylinder.... Now the author has given us the resistances on the piston which amount in the first case to 38·43 lb., and in the second to 23·93 lb. per square inch; and yet he assumes an equal expenditure of water as steam, *in equal times*, in the two cases.... To be consistent, however, with his own rule, above quoted, viz. that the weight of water consumed as steam are to each other as the resistances on the piston, it is obvious that if, in the first case, 3026 lb. of steam passed through the cylinders *in an hour*, 2166 lb. only would have been expended in the second case." And (page 101), "But we have already seen that if the quantity of water were correctly taken in the first case, a less quantity must have been consumed in the second, as the load upon the pistons of the engine in the two experiments deduced from their velocity and assigned resistances, differed in the ratio of 38·43 to 23·93; *and the water as steam consumed, in equal times, must necessarily have varied in the same ratio*, or as 3026 lb. to 2166 lb. It would be fruitless to pursue this analysis further, and vain to attempt the rectification of errors,—a task which properly belongs to the author."

We see that the passage quoted from our work establishes distinctly that when an engine draws two different loads over the same ground, the quantity of water vaporized, *for the same distance*, must be in proportion to the total pressures of the steam in the cylinder. But Mr. Parkes concludes from it, that the quantities of water vaporized, *in the same time*, must be in the ratio of the pressures. But we have proved, in our former paper, that those two consequences are precisely contrary to each other. Therefore the principle alleged by Mr. Parkes, and which he uses afterwards throughout his paper, to "test" the accuracy of the experiments, rests merely upon a new mistake of his own, which consists, as we have said, in making a confusion between the vaporization *for the same distance*, and the vaporization *for the same time.* So that there is no occasion to "attempt the rectification of errors" discovered by the application of this *new* principle.

6th. Mr. Parkes comparing the locomotive with the fixed engines, says, (page 90), "Thus the fixed non-condensing engine is the most economical of the two; but if Mr. de Pambour's data are correct, we must abandon all preconceived opinions, and all belief in the accuracy of pre-ascertained results on the non-condensing engine; we must reverse our engineering creed, and acknowledge the fixed non-condensing engine, with its simple atmospheric resistance, to be far inferior, in economy of steam, to the locomotive, with its plus atmospheric resistance." And (page 98), "for it is utterly impossible that the locomotive should accomplish an equal effect, with $\frac{1}{4}$ less steam than the condensing engine. To go over this ground again would be a mere repetition of arguments previously used."

By these passages it is fully established that Mr. Parkes would, as we have said in our former paper, conclude against the accuracy of the experiments, because a locomotive engine cannot possibly produce a useful effect equal to that of a high pressure non-condensing, or to that of a condensing engine. But we have proved that the case may occur; and Mr. Parkes concedes it himself (pages 156, 157), in saying of a sort of locomotive engine under his charge, "the consumption of steam per effective horse power, per hour, has been shown to be 120 lb. for the fixed non-condensing engine, and for the locomotive under review 112·54 lb., which proves the latter to have been the most economical of the two, at nearly the same absolute pressures. This is a new, and perhaps, an unexpected result." Therefore Mr. Parkes's first objection was good for nothing. But, besides, it must be borne in mind that the velocities used by Mr. Parkes, to calculate the effects of the locomotive engines, being nearly all considerably increased, as has been proved above, he must necessarily arrive at exaggerated results for the effects which he supposes to have been produced by those engines. Therefore this new argument against the accuracy of the experiments, is again the result of his own errors of reasoning and calculations.

7th. To prove that the same unfounded arguments have been urged by Mr. Parkes, and with the same results, against every other engineer who has published experiments on locomotive engines, we need only quote the following passages.

Respecting the experiments of Mr. *Robert Stephenson*, Mr. Parkes says (page 105), "They contain within themselves abundant proofs of error in the quantities assigned to the consumption of water as steam.... Now, if the evaporative data are correct, it would appear by the ratio which the volume of steam consumed bears to that of the water which produced it ($\frac{1}{20}$th being deducted for waste), that the absolute pressure upon the pistons in this case amounted to 81·95 lb. per square inch; but there was only 50 lb. in the boiler! If, therefore, 77 cubic feet of water passed through the cylinders in an hour, in the shape of *pure* steam, the blast-pressure or counter-effort above the atmosphere, was 34·41 lb. instead of $2\frac{1}{2}$ lb. per square inch on the pistons." And (page 106), "Experiment XII. In this case I have assumed an equal evaporation in the same time as in the foregoing experiment; and if $\frac{2}{7}$ were deducted for waste, the blast-pressure would be less than nothing—or a vacuum; for, with the subtraction of $\frac{1}{4}$ for waste, as in the table, the absolute pressure amounts only to 11·10 lb., whilst the resistance required 10 lb. per square inch; and if, contrary to demonstration, it be considered possible that the 77 cubic feet of water were converted into pure steam, and that this quantity passed through the cylinders in the hour, the blast-pressure would equal the whole force required to balance the assigned resistance; for the absolute pressure on the pistons would have amounted to 20·70 lb. per square inch, whilst the sum of ascertained resistance was only 10 lb."

Respecting *Dr. Lardner's* experiments, Mr. Parkes says, (page 110), "It appears, from the tenth conclusion, that the author considers his experiments, so far as they have gone, as giving results in very near accordance. It cannot fail to be remarked that the term discordance would seem to be much more appropriate than accordance to the indications of the last column in the table. But no fair average can be struck from such irregular results; and (page 118), "If the resistance assigned by Dr. Lardner as opposed to the motion of the train be correct, the efficiency of the steam in the locomotive is more than double that obtained by the best condensing engines, more than treble that derived from stationary non-condensing engines, and equal to the performance of a Cornish expansive engine doing a 50 million duty with a bushel of coals."

Respecting the experiments of Mr. *Nicholas Wood*, Mr. Parkes says, (page 129), "The *North Star* affords a sequence of six experiments at velocities varying from $18\frac{1}{2}$ to $38\frac{1}{2}$ miles per hour, but the sequence of results is so irregular as to indicate error in two of them, which I have accordingly marked and rejected, for it is certain that a greater measurable effect must accrue from the expenditure of equal power at 25 than at 30, and at $31\frac{1}{2}$ than at 34 miles per hour; yet the reverse appears on the face of the experiments. It is also equally impossible that a greater momentum should have been generated by a like consumption of force at 34 than at 25 miles per hour."

Respecting the experiments of Mr. *Edward Woods*, with the *Hecla*, Mr. Parkes says, (page 117), "On turning to the tables, and examining the results of this experiment (case 2), it will be apparent:

"1. That a duty has been performed of double the amount effected by the condensing engine, with an equal expenditure of power (column 15).

"2. That the absolute force impressed upon the pistons, as determined by the relative volumes of water and steam was 30·95 lb. per square inch, whereas the tractive effort requisite to overcome the assigned resistance, amounted to 39·28 lb. per square inch, exclusive of the force equivalent to the friction of the loaded engine and blast pressure (cols. 29, 30).

"3. That the power required of the engine to balance the tractive effort alone was $151\frac{1}{2}$ horses, whilst the absolute power furnished by the steam to move the engine, to neutralize the blast resistance, and to overcome the load, amounted only to $119\frac{1}{2}$ horses (columns 33, 34).

"4. That the water expended as steam per horse power per hour, was 37·89 lb. for the tractive effort or duty only (column 42), whereas the condensing engine consumes 70 lb. per effective horse power.

"5. That compared with a fixed non-condensing engine at equal pressure, the locomotive, though labouring against the heavy counter pressure of the blast, from which the other is free, is assumed to have performed equal work, with less than one-half the expenditure of power.

"Such are the incredible results arising out of data purporting to be fairly and necessarily deduced from impeachable experiments."

Therefore we were quite justified to say in our former paper, that it was remarkable that in applying his pretended verifications to all the experiments published on locomotive engines by different engineers, Mr. Parkes had found that the conditions to which he proposed to subject those experiments were not verified in them, and that such a result ought to have put him on his guard against the soundness of his own arguments. But, besides, we have proved that Mr. Parkes has used, in all his calculations, velocities which are erroneously averaged and greatly exaggerated; that he has taken no account of the gravity on the different inclinations of the road; that he has neglected the friction of the engines, the resistance of the air, &c.; that he has calculated erroneously the pressure and volume of the steam in the cylinder, as well as the pressure due to the blast-pipe; that he has tested the experiments by a false principle, grounded upon his confusion of the vaporization for the same distance with the vaporization in the same time; and we shall see very soon that in calculating what he calls the *momentum* generated by the engines, he has wrongly considered the whole weight of the train as raised up in the air by the engine, instead of being dragged or rolled along the rails; all points established upon the very *tables* and *words* of Mr. Parkes, so that he cannot say that his sentiments have been misrepresented; consequently, we were justified also in adding that he heaps errors on errors, combining and complicating them unawares, till he arrives at a point where he does not produce a single result that is not erroneous.

8th. After having shown the material errors and general misreasoning which pervades the whole of the strictures of Mr. Parkes against our researches and those of others, we come to the *Critic's* own conception, that is to the calculation of the mechanical effect of locomotive engines, by what he calls the *momentum* generated. He says, (page 128), "Column 2 exhibits the momentum, or product of the mass, in tons, of the engine, tender and train, multiplied into its velocity in feet per second; and the sums thus represent the respective mechanical effect produced per second by each engine." And (page 130), "Four means are derived from these results. Mean 1. informs us, 1st, That when the velocity is increased in the ratio of 1·52 to 1, an increased consumption of power is required for the production of equal mechanical effects, or of equal momenta, in the ratio of 1·43 to 1, being somewhat less than in the direct ratio of the velocities. 2nd. That power is expended in the ratio of 2·43 to 1, or in about that of the square of the velocities to produce equal gross commercial results. 3rd. That power is expended in the ratio of 3·11 to 1, or in not much less than that of the cubes of the velocities, to realize equal useful commercial results."

So, in our former paper, we have properly cited Mr. Parkes, and therefore our conclusion is correct, that what he calls *momentum* is nothing more or less than the common useful effect (weight of engine included), as explained in every work upon that subject; with the exception that, here it is wrongly calculated; and to be convinced that it is wrongly calculated, it suffices to give a glance at table XVI., page 143, of Mr. Parkes's paper. There we see that the *Atlas*, in experiment I, produced a *momentum* equal to 206·90 tons, gross load of the engine (column 5), multiplied by 14·263 feet per second, mean velocity of the engines per second (column 9), equal to 2951·01 tons moved one foot per second (column 11). This *momentum* or *mechanical effect*, reduced in pounds, is equal to 6,610,262 lb. moved one foot per second, or to 396,615,744 lb. moved one foot per minute. Now, if we observe that a horse power is expressed by 33,000 lb. moved one foot per minute, we shall see that the *momentum* produced by the *Atlas*, in that experiment was equal to

$$\frac{296,615,744}{33,000} = 12,019 \text{ horses.}$$

Experiment II. exhibits a momentum equal to 12,504 horses, experiment III. a momentum equal to 5,862 horses, and so of the others. The *North Star* alone produced a *momentum* or *mechanical effect*, equal to 21,668 horses. These extraordinary results proceed from Mr. Parkes taking erroneously the total weight in tons, for the resistance moved, as if the whole train were *carried up in the air by the engine;* whereas the true resistance overcome in rolling the train along the rails, is only at the rate of about 6 lb. per ton of weight; besides the friction of the engine, the gravity, the resistance of the air, &c., neglected by Mr. Parkes.

Certainly, then, we were quite right to say that calculations like these do not tend to the progress of science, but that they would rather lead it back to its first rudiments; and if we have added, besides, that Mr. Parkes *has not made one experiment on locomotive engines*, it is a fact that can easily be verified in looking at his table XVI., from which he has drawn his *momenta*. In column I. of that table, the name of every one of the experimenters is given, and there is not one experiment in the name of Mr. Parkes. So that a man so fertile in strictures against the experiments of others, has not made a single one, himself.

I must now say a few words on the letter of Mr. Parkes, lately inserted in several periodicals, in support of his former strictures against my experiments on locomotive engines. It would seem from that letter, that I have attacked Mr. Parkes, but mere dates will easily settle that point. The attacks of Mr. Parkes against me will be found in his paper, *On Steam-boilers and Steam-engines*, inserted in the *Transactions of the Institution of Civil Engineers*, vol. III., with the date, London, 1839, given (page 162) at the end of the paper. In this writing I am attacked almost without interruption, from page 77 to the end. The alleged inaccuracy of my experiments is presented under all possible forms, as the necessary consequence of the results obtained by Mr. Parkes in his tables. It was then incumbent upon me to protest against any conclusions drawn from these tables, and to prove that they are, as well as the reasonings of the *Critic*, an uninterrupted series of mistakes. Therefore I published an answer in the introduction to the second edition of my *Treatise on Locomotive Engines*, Weale, 1840, and afterwards printed it again with more details and full references, in the *Civil Engineer and Architect's Journal*, September 1841. This date, and the whole subject of the paper itself, show sufficiently that it is but an answer to the unfounded strictures of Mr. Parkes.

Now that I have established that, in my refutation of the criticisms of Mr. Parkes, I have not misrepresented his sentiments, it would be very easy, and completely justifiable, to add some observations upon the expressions used by Mr. Parkes in his letter, to support by words what he could not support by arguments. But, as it is my decided intention to keep distinct from any discussion foreign to the scientific question, I shall abstain from presenting any remark on the subject, begging only the persons who want to form a precise judgment of this controversy, to read the letter of Mr. Parkes again, after having perused this paper, and then to make their own observations.

G. De Pambour.

GREAT WESTERN STEAM SHIP COMPANY.

The question about the legality of the Great Western Steam Ship Company carrying on a marine engine factory has now been decided, the supporters of such an absurd plan have at last been compelled to come forward and concur in their own defeat, a circumstance not to be regretted, when it is considered with how much pertinacity they stuck to their bantling, and how determined they were in their endeavours to foist it upon the unwilling shareholders. As it is, a great loss must be incurred in the disposal of the property, independently of the waste which must have been caused by the maintenance of the establishment, and the victimized shareholders remain without any remedy against those who have so grossly abused their trust. When individuals embarked their property in the Great Western Steam Ship Company, marine engineers especially, they never contemplated that the funds of the Company were to be applied to any purpose but the legitimate one of engaging in the carrying trade, they did not expect that their money was to be wasted in rivalry against themselves, or that the company was to go to the expense of hazardous experiments. Yet scarcely had one ship been launched, before the directors, who had barely capital enough to fit out another ship, set up a large building yard and an engine factory, intended for executing machinery on the greatest scale. The result it wanted but little sagacity to foresee; it was a sad destruction of the Company's prospects, and a serious injury to their revenue, for while these experiments have been going on, the North American and West Indian Mail Companies have launched each half-a-dozen steamers, and have set them to work. Where, however, is the Mammoth? she has not even her hull finished, and when she will be launched no one can tell. As to the propriety of any company, except one with a fleet of vessels, like the General Steam Navigation Company, engaging in ship-building or engineering, it is preposterous, and still more so where there is only a paltry amount of capital available for the purpose.

The next question is whether it is at all proper for a joint-stock company to engage in such a business as marine engineering, and we have no hesitation in saying that no company is justified in undertaking any thing of the kind. We think it more necessary to dwell upon this point, as some ambitious individuals are endeavouring to form a separate company for the purpose of carrying on the rejected steam factory, which will as certainly prove a loss to its new proprietors as it has to the Great Western Company. There is no rule laid down which applies more clearly to this case than that which governs the constitution of joint-stock companies; it is expressly defined that a joint-stock company can only safely engage in such pursuits as are beyond the capital or credit of a private individual, and that any company, endeavouring to compete with private enterprise in its own proper sphere, must sustain a loss. Now, surely, with regard to steam ship building, it cannot be said that there is any call for a company to engage in it, as the private parties who now carry it on have proved themselves fully competent, having, during the present year, supplied not only the English government, but other governments with steam frigates, and having turned out of their yards a fleet of first-class vessels for the North American and West Indian stations. There is no call for a company, every one is satisfied with the present system, and the Great Western Steam Ship Company, or the Steam Ship Factory Company, must lose largely in a ridiculous contest with a small capital against the Maudslays, Sewards, Millers, Lairds, Napiers, and Acramans, of the great steam ports. We therefore conjure the Bristolians to beware of the snare which a few ambitious men are getting ready for their downfall.

Malta.—It has been determined by the Admiralty to erect at Malta a biscuit baking apparatus on the plan of Mr. T. T. Grant; it will be situated over the galley arches. We have heard also that a dock is forthwith to be constructed in the dock-yard there, on a site pointed out by Captain Brandreth, and for that purpose a contract has been made in Catanea for stone of an admirable quality, equal to granite, but in reality lava, which is to be delivered on the spot, ready worked for use, at 2*s*. 9*d*. only the cubic foot.

SMOKE NUISANCE IN LARGE TOWNS.

At a Court of Common Council held at Guildhall, London, on the 11th October last, Mr. Anderton presented a Report of the Committee appointed to inquire into the nuisance arising from smoke of manufactories and steam engines, &c., and the best means of obviating the same.

The following is the document referred to:—

To the Right Hon. the Lord Mayor, Aldermen, and Commons of the City of London, in Common Council assembled.

We, whose names are hereunto subscribed, your committee for general purposes, to whom on the 29th day of October last it was referred to inquire into the annoyance and nuisance to which the inhabitants of this city are subject from the smoke of manufactories and steam-engines, and also from steam-boats on the river Thames, and the best means of obviating the same, and to report thereon to this Court, do certify, that with a view of collecting every information upon the subject we directed advertisements to be issued, intimating the nature of the reference to us, and expressing our desire to receive any suggestions in writing as to the best means to be adopted for remedying the inconveniences complained of, and in consequence thereof we were favoured with communications from upwards of 41 parties, suggesting a variety of modes for that purpose, and for the better information of this hon. court we have classed and arranged the same under the following heads:—

1. Parties tendering general advice.
2. Methods for the combustion of coal and the prevention of smoke, by the introduction of fresh or undecomposed air into the furnaces.
3. Methods for the purpose of coking or charring the coal in furnaces, such furnaces forming part of the ordinary furnace of steam-boilers, coppers, &c.
4. By the introduction of a jet of steam, in conjunction with a jet of air, into the furnace of steam-boilers.
5. By the use of anthracite, Welch coal (either Langannoch or Merthyr), or coke.
6. By compressed fuel.
7. Parties possessing plans, but at present unexplained.
8. General complaints, but no remedy proposed.

Class No. 1.

Number of Communication.

17 Hood, C., Earl-street, Blackfriars.
33 Reid, Dr., 15, Duke-street, Westminster.
39 Wright, J., Hart-street, Bloomsbury.

Class No. 2.

15 Hazelden, W., at Mr. Bewley's, Liverpool.
5 b Bewley, John, Brunswick-street, Liverpool.
18 Hall, Samuel, 18, King's Arms-yard, Moorgate.
41 Dircks, H., at Routledge, W., 38, Prince's-street, Manchester.
11 Forrester, R. F., Derby.

Class No. 3.

1 Acraman and Co., Bristol Iron Works.
5 a Chanter, John, Earl-street, Blackfriars.
7 Dartmouth, Earl of, St. James's-square.
19 Juckes, J., 95, Union-street, Borough.
30 Rodda, R., St. Auste, Cornwall.
36 Thompson, R., Liverpool.

Class No. 4.

3 Bell, W., 11, Queen-street, Edinburgh.
9 English, 37, New Broad-street.
13 Greaves, W., Westgate-street, Newcastle.
34 Smith, W., Police-office, Aberdeen.

Class No. 5.

4 Barber, E. S., Newport, Monmouthshire.
5 Coles Child & Co., Belvedere Wharf, Lambeth.
10 Flisher, Parker's-terrace, Bermondsey.
12 Fyfe, Andrew, Edinburgh.
16 Hinde, J., 39, Chester-terrace, Regent's Park.
20 Langannoch Coal Company, Crosby-hall Chambers.
23 Manby, Brothers, 22, Parliament-street.
24 Mackay, W., Swansea.
25 Nutting, H., 37, Noble-street.
27 Pocock and Sons, St. Bride's Wharf.
29 Pritchard, D., Capeldewy-house, Carmarthen.
32 Rowton, F., 2, North-place, Kingsland-road.
35 Seale, Henry, Merthyr Tydvil.
37 Vickery, T. W., 25, Lincoln's-inn Fields.
39 Wright, J. Hart-street, Bloomsbury.

Class No. 6.

26 Oram, Thomas, Lewisham.

Class No. 7.

6 Dez Maurel, 3, Newington-terrace, New Kent Road.
8 De Varoe, E. H., Bryanston-street, Portman-square.
14 Griesbach, W. H., 6, Baker's-row, Walworth.
22 Miller, W., surgeon, Poole.
28 Parsons, John, Whitecross-street.
31 Reddell, Brothers, Bow-common.
38 Williams, John, Pitmaston, near Worcester.
40 Wood, W., Croydon-common.
4 a Brinley, R. J., 121, Leadenhall-street.

Class No. 8.

2 Ansell, S., West Hackney.
21 Misokapnos, Cannon-street.

Class 1.
General Advice by Papers, Books, &c.

The papers and communications of Mr. Charles Hood (No. 17), Dr. Reid (No. 33), Mr. C. W. Williams, presented by Mr. Henry Dircks (No. 41), are of too valuable a character to be curtailed (particularly the latter). The whole subject is handled in a manner that would, if put fairly in practice, completely do away with the smoke, and be attended with highly beneficial results to the proprietors of steam-engines, manufactories, and others using coals in large quantities; it will be needless here to refer to any particular point, as the whole are included, by the methods to be considered, as they present themselves in the following classes:—

Class 2.
Methods for the Combustion of Coal and the Prevention of Smoke by the Introduction of Fresh Air into Furnaces.

Mr. W. Hazelden (No. 15) writes a favourable report of a furnace patented by a Mr. Andrew Kurtz, and of which patent he has a share; he further states that a saving of 22 per cent. in fuel has been effected by the use of this patent. Their terms are liberal, and they are willing to allow any engineer appointed by the committee to examine and report upon the same.

John Bewley (No. 5 b), on the same patent, writes that the plan is simple and easy of application to the great majority of steam-engines; that he is agent for this patent, and shall be happy to show the plan in operation to any person conversant with such matters, and give them the opportunity of testing the same to their entire satisfaction.

This patent, we believe, consists of a series of hollow fire-bars forming an inclined plane, the highest end being next the bridge; through these bars air is admitted from thence through small openings in the bridge. This air, mixing with the gases from the fuel, forms an explosive mixture which readily fires; thus doing away with smoke, &c.

Samuel Hall (No. 18) is the patentee of a plan much of the same nature. His method is to place a quantity of pipes in the flue between the boiler and the chimney. Air is admitted through those pipes, thence it passes in flues or tubes to perforations in or near the bridge. The office of the tubes (placed in the chimney throat) is to intercept and return a portion of the heat (which would be lost up the chimney) to the fire, and to warm the air admitted for the purpose of forming an explosive mixture with the gases.

Mr. Samuel Hall thus writes—

"If you will select a stationary engine, and one on board a tolerably large steam-boat on the banks of the Thames, for the application of my apparatus, I will furnish it and put it up to the engines at my own expense, to be paid for at a moderate price (to be previously agreed on) if it answers the purpose; but if not, to be taken away also at my own expense, and the success or non-success of the process to be left to your decision."

Numerous testimonials accompany this communication.

R. F. Forester (No. 11) is a testimonial of more recent date (in favour of the foregoing), and since the advertisement has been put in by our directions.

Henry Dircks (No. 41)—This communication is principally in explanation of a patent by C. W. Williams, of Liverpool, which is for the admission of fresh air through small orifices placed in the flame bed behind the bridge, stating that by the use of this apparatus, the air (forming the explosive mixture with the gases) will be more divided and mix more readily, and the combustion will be more perfect. He at the same time uses a perforated plate, or a series of tubes in the ash-pit beneath the fire bars, thus insuring a more perfect and economical combustion of the coke or charred coal on the bars, and by this process the Newcastle coals possess every advantage of the Anthracite, Langannoch, and other Welch coals.

A variety of testimonials in favour of the process from the most eminent chemists accompany the communication.

Class 3.
By the method of coking or charring the coal in furnaces, forming part of the ordinary furnace of steam-engines, &c.

John Chanter (No. 5 a) is the patentee of a number of plans for the purpose just described.

His combination, as he now describes it, is as follows:—To the front of the common boilers now in use, he places an "auxiliary boiler," which is connected to the principal boiler by both water and steam pipes, thus insuring a circulation of the water. Under this supplementary boiler he places the fire bars, laying them lowest at the back end (the inclination being six or eight inches to the foot) beneath these fire-bars he places a plate of iron, which he terms a "deflector;" this is for the purpose of warming the air (feeding the fire on the bars) by reverberation. At the lower end of this furnace a common furnace is constructed, which receives the coke or charred coal in an incandescent state from the upper bars.

Thus when coal is thrown into the upper furnace, the smoke, in its passage to the chimney, has to pass downwards over the clear burning fire on the bottom bars.

Acraman and Co. (No. 1).—This communication is a letter to Mr. Chanter on the last subject, and on the utility of such patent when applied to marine engines. Also a list of questions submitted by them to Mr. Thompson, resident engineer, at Liverpool, for the British and North American steam-boats, all of which are answered in a very satisfactory manner by the latter gentleman.

R. Thompson (No. 36).—This is a letter from this gentleman to Messrs. Acraman & Co., of Bristol, containing a favourable report on the application of Mr. Chanter's plan to the Enterprise steamer, of Glasgow.

Earl of Dartmouth (No. 7).—This communication is in favour of a plan of Mr. Hall, of Leeds, and is the only notice of this principle. This we believe is the plan adopted:—A division is formed longitudinally or otherwise in the fire-place, thus forming two furnaces, which are fired alternately, the smoke and gases arising from the fresh fuel in one furnace is destroyed by passing over the bright fire of the other. The noble Earl states that he has applied the apparatus to some boilers in Staffordshire, and it causes them to consume nearly the whole of the smoke.

J. Juckes (No. 19) is the patentee of a plan for consuming of smoke, and saving of fuel. The method he uses is as follows:—

"In the centre of a common fire-place he places an apparatus which receives the coal from a hopper, the coals so placed are introduced into the furnace beneath the fire, instead of being thrown in from above and upon the coals under combustion in the usual manner; by this plan, the gases (arising from the fresh fuel) are destroyed by passing upwards through the coke or charred coal under combustion.

When the coal so admitted becomes caked, the feeder is again lowered, and a free vent or passage is formed for the admission of fresh air into and through the burning fuel. The patentee is willing to give reference or information.

R. Rodda (No. 30) is the patentee of a plan for the consumption of smoke and saving of fuel. His method is to divide the furnace into two parts, the fresh coals are put in the first division to coke, and are then thrust back into the second division; the gases arising from the fresh coal pass through lateral openings into the second division, where they are destroyed by the bright fire. A stream of fresh air is admitted joining the smoke in the passage, thus rendering it more fit for explosion.

A list of testimonials from the houses of Messrs. Barclay, Perkins, & Co., Messrs. Truman, Hanbury, & Co., and others, accompany the communication.

Class 4.

By the introduction of a jet of steam, in conjunction with a jet of air, into the furnace of steam boilers.

W. Bell (No. 3).—This communication is in favour of a plan patented by Mr. Ivison, of the Castle Silk Mills, Edinburgh. The method he uses is to admit a portion of steam through a small pipe into a finely perforated fan branch placed in the furnace, whilst at the same time openings are made into or near the bridge. Through these openings fresh air is admitted, which air and steam mingling with the gases arising from the fuel under combustion, forms an explosive mixture which readily fires, thus destroying the smoke.

A report from the Manchester police accompanies this communication.

Mr. English (No. 9) is the editor of the *Mining Journal, Mining Review*, &c. In his communication he directs attention to notices of Ivison's and other patents contained in the above works, most of which have been described in the present papers.

W. Greaves (No. 13) also notices Ivison's patent, he being agent in Newcastle for the said patent. He further advises the use of coals known by the name of Leaze's Main, which, in conjunction with the said patent, produce but little smoke.

W. Smith (No. 34) writes that Ivison's patent has been applied to an engine belonging to the police-office, Aberdeen: the smoke is in a great measure consumed, and that a saving of coal is effected.

Class 5.

By the use of Anthracite Welch coal (either Langannoch or Merthyr) or Coke.

All the communications which are classed under this head show that fuel of the above description can be procured in any quantity, is perfectly free from smoke, and would be found as economical as the Newcastle or other descriptions of coal.

Class 6.

By the use of compressed Fuel.

Thomas Oram (No. 26).—This communication states, that the patentee has a method of preparing the compressed fuel, which will emit but little smoke, has a greater power of heat than the best coals, and of a much lower price to the consumer. A sample of the fuel accompanied the communication, a portion of the same has been burnt, and we find but little smoke emitted, but without analysis it would be difficult to form an opinion.

Class 7.

Parties possessing plans, but at present unexplained.

Dez Maurel (No. 6).—Of this we cannot do better than give the following translation:—

"Invention of an apparatus to prevent chimnies taking fire, exempts them from cleaning or sweeping, and which does not allow any soot to escape from the top.

"The inventor proposes to make the following demonstration:—There will be constructed, at the expense of the committee, a chimney, of which the tower is to be 20 feet high, and made of wood. The part nearest the fire shall be tarred in order to demonstrate the impossibility of its taking fire; and the upper part shall be whitened, in order to be assured of the nullity of action of the smoke destroyed by the apparatus.

"In the fire are burnt pit-coal, wood shavings, oil, and essence of turpentine, and after this the apparatus shall be taken away, and in less than half an hour the white part of the tower will be entirely coloured. The apparatus (of which the price is very moderate) is of long duration, and requires but one minute to clean it."

Mr. Eugene de Varoe (No. 8).—This memorial showeth that he hath invented an apparatus by which the soot or carbonic portion of smoke is destroyed, and the gaseous portion rendered harmless; it is easy of adaptation; chimney-sweepers are rendered unnecessary; an impossibility of overheated flues; would render the atmosphere of London as pure and serene as the cities of the continent, and would give an additional security to life and property. Has performed experiments before men of science, and would feel honoured by the commands of the Court of Common Council to perform such experiments as would demonstrate the utility of the invention.

W. H. Griesbach (No 14) showeth, that if 50*l.* be placed at his disposal (in consideration of his time and expences), and the use of a steamer, he has no doubt of removing the nuisance complained of. The expense of the experiment to be borne by the parties interested. In the event of success, a sum of money (the amount previously determined) to be paid to him; and further, did he not receive an answer to his communication, dated the —— day of ——, he should leave for the continent in a few days.

W. Miller (No. 22) showeth, that he has discovered a method of preparing coal by a simple process, which has the desired effect, and should be happy to submit some coals thus prepared, at any time, in London.

John Parsons (No. 28) showeth, that he has invented a plan, by which the nuisance complained of may be got rid of, as also the inconvenience arising from smoky chimnies of houses in general. That his plans have been tested, and found perfect; and he would be glad to explain to any person appointed by the committee.

Reddell Brothers, (No. 31) show that they are in possession of a plan by which the object could be gained; that it is very simple and self-evident upon explanation, and they would be happy to give such explanation to any person appointed by us. The plan would meet with the cordial support of the fire insurance companies and of the public generally.

John Williams (No. 38) showeth, that he has tried different experimeuts, and at last succeeded in finding one perfect, which would completely do away with the nuisance complained of; and, if allowed a little time, he intends publishing a treatise on the subject, the profits of which he purposes giving to some institution in the part of the country where he resides.

W. Wood (No. 40) showeth, that he has invented a plan which would have the desired effect, is easy of application, and, in the case of stationary engines, would be much cheaper than the methods used at present. He would be happy to show his plans to any person appointed by us at a few days' notice.

R. J. Brinley (No. 4 a) refers to an article in the 7th volume of *Chambers' Edinburgh Journal*, in which there is a thing detailed calculated to effect the object required, and would be happy to lend us the volume in question.

Class 8.

General Complaints, but no remedy proposed.

S. Ansell (No. 2) complaining chiefly of the annoyance arising from the ropes of the Birmingham railway at the Euston station, and the Blackwall railway, through the eastern part of the metropolis.

Misokapnos (No. 21), complaining of the deficiency in height of the chimney belonging to Messrs. Calvert's brewery.

At the same time your Committee feel we should not do justice to the several parties if we did not annex the whole of their plans and communications to this report, and to state, after a careful perusal of the same, that it appears to us to be highly desirable that the nuisance arising from the smoke of steam-engines and manufactories should be abated, and that we have no doubt a remedy may be found which will remove the annoyance complained of, and be attended with economy to the owners of steam-engines and manufactories generally; and under this conviction we recommend this hon. court to present petitions to both Houses of Parliament, complaining of such nuisance and annoyance, and praying that a law may be passed to prevent a continuance of the same.

And we are further of opinion that this Report should be printed, and copies thereof sent to the members of the legislature and of this hon. court, to the authorities of Birmingham, Sheffield, Glasgow, and all the other large manufacturing towns likely to be affected by smoke from steam-engines; and also to the principal engineers and scientific institutions of the metropolis: and we recommend the same accordingly.

All which we submit to the judgment of this hon. court.

Dated this 15th day of September, 1841.

J. W. ANDERTON.
JOHN RANS.
GEORGE SEISON.
E. EYTON.
CHARLES BOND.
WILLIAM MUDDELL.
JAMES HOOLE.
J. MUSGROVE.
JOHN ADAMSON.
W. SIMPSON.
GEORGE M'KENZIE.
JAMES DAVIES.
W. A. BECKWITH.

The report was then ordered to be printed and circulated, and taken into consideration on a future day.

After the transaction of some further business, the Court adjourned.

ENCROACHMENT OF THE SEA AT DOVER.

Tuesday Evening, 19th October.

DURING the last three or four days the very boisterous weather which all along the south-eastern coast has more or less been detrimental to the shipping interest, has done considerable damage at Dover, carrying away an immense quantity of beach, and undermining a number of boat-houses and other small buildings which had for a number of years past bid defiance to the fury of the waves. In the bay, which to a considerable extent was sheltered from the wind and tide by the projection of the pier, several boat-houses opposite the Royal York Hotel have been washed down. For several days past, during the time of high water, the waves have come rolling into the bay in such awful grandeur as is rarely witnessed on this coast, carrying back with them the shingle to so great an extent that the sea now washes in 10 or 15 feet nearer the Marine-parade and Waterloo-crescent than it formerly did. The greatest destruction of property, however, has been to the westward of the Stonehead. Here, where the beach used formerly to accumulate in great quantities, and passing hence to the mouth of the harbour, whereby a free ingress and egress to vessels was prevented scarcely a pebble is to be seen—a phenomenon never before witnessed by the oldest inhabitant.

What can be the cause of this extraordinary circumstance, is difficult, perhaps, to determine, although the most probable conjecture is, that the enormous fall of chalk at the Round Down Cliff, about twelve months since, has stopped the progress of the shingle beyond it, in travelling to the eastward, as it used to do. But some persons, who have paid considerable attention to the subject, conclude that it arises from the large quantity of beach used in the construction of the sea-wall between this town and Folkestone. The circumstance, however, from whatever cause it may arise, is a subject for deep regret, as the presence of the beach was a great preservative to the town, while its absence has been the sole cause of the late destruction of property.

We have not been able to ascertain the amount of the damage sustained in this part of the town, but as the buildings belonged principally to boatmen and the humbler classes of society, they are of a serious nature; whilst future gales threaten more extensive destruction, unless something be done to check the raging waves. Further onward is the Bullock rock, on which is built Archcliff Fort, the residence of Colonel Munro, R. A., the commandant of the garrison. The base of this rock we perceive has also been undermined to a very great extent by the washing of the sea, and as there are several large clefts in various parts of it, there is every reason to fear that a portion of it will soon give way. The houses beyond this rock have been by the late gales placed in imminent danger. The platform on which they were built, and which extended several feet in front, has nearly all been carried into the sea, and some of the smaller buildings, one of which was the residence of a poor family, have been pulled down to prevent the materials being washed into the sea, and to make a road to the other houses. The platform leading to the entrance of the tunnel under Shakspeare Cliff, which was many feet in width, has also disappeared, with the exception of a narrow slip; but as a second tunnel is yet to be excavated, we do not apprehend that it will be of any loss to the South Eastern Railway Company. One thing, however, is now quite certain—the company will not be able to make the railroad in this place stand, without going to the e pense of erecting a wall to defend it from the encroachment of the sea; and this, it appears to us, would be advisable before the Dover terminus of the tunnel be commenced, if the materials for the construction of the same can be obtained. The whole of the beach, as we before observed, having been carried away, nothing now remains to prevent the sea washing against that vast and stupendous cliff which Shakspeare has immortalized, and we perceive that even here also the raging surf seems fully bent upon destruction. A large quantity of several thousand tons' weight fell into the sea on Sunday last, near the mouth of the railway tunnel, and many other huge masses may be seen at a distance tottering over an excavated base. A walk, therefore, beneath this cliff may now be considered as extremely dangerous.

The attention of many of the inhabitants of Dover is now turned towards the object of preventing the sea making any further encroachments on the town, and for this purpose a deputation of them yesterday morning waited on Mr. Jenkinson, the Deputy Lieutenant Governor of Dover Castle, to ascertain if any assistance could be rendered by the Harbour Commissioners. The deputation was received by Mr. Jenkinson with every mark of respect, and he informed them that everything that he, as a Harbour Commissioner, could do should be done, and that he would immediately communicate with His Grace the Duke of Wellington on the subject.

A STEAM BOAT OF A NEW CONSTRUCTION.

(Abridged from the *New York Herald*, August 7.)

THE new steam boat, the *Germ*, is arrived in our waters, and has made an experimental trip off the Battery. Lieutenant Hunter, the inventor of this boat, and Captain Hosken, of the Great Western, took a trip in her yesterday, through our harbour and round the North Carolina, and were highly gratified with her performance. This beautiful little vessel is just 50 feet in extreme length; width of beam at the water line 9 feet, at the gunwale 11 feet. The area of her displacement at the greatest breadth of beam is a fraction over 20 square feet. She is propelled easily 8 miles an hour; and, with better engines, could easily be propelled 11 miles an hour. She has two engines; each of which, f properly constructed, would be equal to what is called five horse power; they are, however, so indifferently arranged, as to work at a loss of one-third of what should be their power; and have therefore together but six and two-thirds horse power. Calculating on this data, it will be seen that the propulsive power used in the "Germ" is equal to one horse for every 3 square feet; whereas the propulsive power used for our fastest steamers it equal to three horses for every square foot of displacement. The contrast, therefore, is very great. The well established fact, that the power necessary to propel a vessel is estimated by the area of her displacement at the greatest breadth of beam, and the advantage of speed known to resu't from great length of keel, and the application of paddle wheels of greater diameter, leaves us the interesting and valuable truth clearly self-evident, that the submerged horizontal paddle-wheels (like that in the Germ) is a much more efficient propeller than the paddle-wheel now in use. The great advantages consequent on the use of this new kind of propeller, for ocean navigation, is too evident, therefore, to require much stress. By its lateral action, the movement of the vessel is always under control; she is in no danger from broaching to, or bringing by the lee; as by the peculiar power of her paddles in the lateral action, she can easily be brought out of the trough of a sea, and be made to "head it," without the aid of a rudder, or without headway on her. And, more than this, the propellers being at all times submerged, the vessel moves through head sea with but little diminution of her speed. The Germ has the appearance of a handsome canal boat. No wheels are seen, very little smoke, and a very small escape pipe, are all that tell she is a steam boat. She moves with great velocity, and perfectly noiseless, with scarcely any rippling of the water. She turns easily, almost upon her own centre. Half the boat is formed into a neat cabin; the forward half is occupied by the engine and boiler, which is on the high-pressure plan. The boiler is made on the locomotive plan (and it appears to have been a locomotive boiler, at some time), with cylinders attached to it, larboard and starboard. In the cylinder works a small piston rod 18 inches long, from this extends the connecting-rod, about four feet long; and this last rod is attached directly to the paddle-wheel crank. The crank on each side is connected with a vertical shaft that works the paddle-wheels exactly like a man working two coffee mills with his two hands. The great feature in this boat, that is the propeller, consists of a hollow iron hub, four feet diameter, with paddles made of boiler iron radiating from it. The superficies of each paddle is one-half of a square foot, therefore the whole diameter of the paddle wheel is exactly five feet. There are two of these paddle wheels, the space between them being occupied by the keelson. These paddle wheels cannot be injured by the vessel's grounding, for the bottom of the vessel (which can be made of any desired thickness) is always below the paddle wheels, ground where she may. The Germ has an advantage over all vessels otherwise propelled, in not requiring a rudder to direct her course, by reason of the lateral action of her wheels. She has a rudder, but it is more for convenience than actual use. It will be easily seen, too, that the hull of a steamer thus constructed must be subject to less wear and tear than all others, for the power of the engine is imparted in a line with the keel, and at a point most available for propelling. Again, the paddle wheels are not subject to the irregular action of the sea, and therefore they have always a uniform resisting power, and her engines work smoothly.

On the other hand, if a vessel thus constructed chose to use sails, her paddle wheels offer less resistance than those of any other steam boat; take off the connecting rods and her wheels do not present a resistance of half a knot out of every ten knots. Her paddle whee's are of iron, made very simple but strong. They are not liable to get out of order; and although made of boiler iron, are so buoyant as to float, owing to the displacement caused by the hollow hub in the centre. Such is the Germ, and such is the new and important principle in the propulsion of vessels which has been conclusively established by the performance of this little vessel.

The fitness of these propellers to canal navigation has been fully settled by the actual working of the Germ on several canals, and the privileges already given to Lieutenant Hunter, by the directors, for the use of his valuable improvement.

MR. BROOKS IN REPLY TO MR. BARRET ON BARS OF RIVERS.

Sir—In reference to the letter by Mr. Barrett in your July number, I shall merely notice the statements that gentleman makes in defence of his own theory, and this for brevity's sake only, else I should seek to refute the false positions and strained unfair inferences with which the whole is filled. I purpose, therefore, to confine myself to the disproval of his theory and not allow him "to go off upon another tack," as he seems inclined to do by a statement which contains no notice of his much talked of theory, which is as follows: "The cause of the existence of bars is the conflicting action of effluent currents or tides, passing into the ocean *at right angles* to the shore;" and he adds as his remedy for the removal of the bar, "But if the current or tide be by artificial means conducted into the ocean so as to join the sea tide *at an acute angle*, no conflicting action can arise, and then no bar will accumulate." On the above I have stated, in page 5 of my Treatise on Rivers, "That the *casual direction* of the lower reach, or position of the mouth of a river, cannot be truly assigned as the cause of the existence of bars, is easily proved by observations on rivers subject to great variations at their entrances; the bar being always found to exist quite independent of the direction of the discharge into the sea. This fact at once refutes the third and fourth theories which have been noticed above." In the preceding, the words "independent of the direction of the discharge" mean evidently independent of "the great variations" or "casual direction of the lower reach before alluded to; but Mr. Barrett in reply states "In this extract there seems to be two distinct facts, *i. e.* the casual direction of the lower reach, and the independence of a bar, in the direction of the discharged waters: that is, he means that the deposit or bar does not occur in the direction of the egress waters. With respect to Mr. B.'s assertion of the independence of the bar of the egress waters, I have much to say, if he be correct, he has indeed "at once refuted my theory."

I submit to the judgment of your readers whether the language quoted from my work, which, be it remembered, is in direct reference to the theory by Mr. Barrett, which bases the existence of bars upon the casual direction of the discharge, can by any fairness be construed into the meaning attempted to be put upon it by Mr. Barrett to cover his own want of arguments, or facts in support of his theory? I have not made any "assertion of the independence of the bar of the egress water," the plain meaning of my language to any common understanding is, that whether the discharge into the sea be effected at either a right, or at an acute angle with the shore, the former case, or a rectangular direction of the discharge, will not cause the formation of a bar: and the latter, or where the direction of the discharge makes an acute angle with the shore, will not prevent the formation of a bar, or have any effect upon its removal; and therefore I am correct in stating that the existence or non-existence of a bar *is independent of the casual direction* of the discharge. It is disingenuous in Mr. Barrett to try to make me appear to have said "that the deposit or bar does not occur in the direction of the egress waters," inasmuch as my reply to his theory plainly states that whatever be the casual variation of the direction of the discharge, the bar will still be found attached to it; whereas, according to Mr. Barrett's theory, the bar ought to disappear by a certain change of direction of the discharge. The whole of Mr. Barrett's long lectures on bars may be included in the simple statement that he believes that a bar is caused by the discharge of a river taking place in a direction at right angles to the line of shore, and that there will be no bar when the discharge takes place in a direction which forms an acute angle with the shore. These are his assertions, which, however, he does not support by a single practical example.

Mr. Barrett's theory on the cause of bars rests solely upon the direction of the discharge, and I submit to your readers' judgment whether I have, or have not, sufficiently refuted it by showing that bars are as frequently found at the mouths of rivers which discharge their waters at acute angles with the shore, as at the mouths of those which are discharged in a rectangular direction. In illustration of this statement, even the youngest of your readers will bring forward many examples. It is, however, Mr. Barrett's duty to support his statement by bringing forward a mass of examples of rivers, which are obstructed by bars because of the rectangular direction of their discharge, and of others which are from bars because of their discharge being effected at an acute angle with the shore. In doing this, of course Mr. Barrett will not omit to notice those rivers which are free from bars, notwithstanding their rectangular direction of discharge, nor will he omit those numerous rivers which have bars, notwithstanding their discharge is at an acute angle; if he do omit to notice them, I promise to amply supply his deficiency. In Mr. Barrett's last letter I looked for practical examples to illustrate his theory on the bars of rivers, the matter in dispute! and in lieu I find advanced as proofs of his accuracy, "the Bay of Wangarver, New Zealand;" and "the Bays of Plenby and Port Nicholson" as "free from bars"; Mr. Barrett might just as appropriately have referred to the Bay of Fundy or the Baltic Sea. This same letter contains specimens of the powers of observation and of "the devotion" of which Mr. Barrett boasts so much; and I might also add, that it contains specimens of his *taste* where, writing of the "Neva, Gulf of Finland, Narva, Dantzic, Danube, Nile, he adds, "*no salt water being in the vicinity of the disemboguing site of the above rivers*," and he also adds, "that there is an absence of sloping to these rivers." By Narva and Dantzic, Mr. Barrett doubtless meant to have alluded to the Rivers Narova and Vistula; but what does Mr. Barrett mean in another part of his letter where he writes "Norway, Scotland, Ireland, Scilly Islands, Minorca, and Malta Harbours are of the first kind?"

I am your obedient servant,
W. A. Brooks.

Stockton-on-Tees,
12th July.

RULES FOR CALCULATING THE HORSE POWER OF STEAM ENGINES.

Sir—The rules for calculating the horse power of steam engines in the Clyde have long been known to be different from those employed by the English manufacturers, and it appears to me that the charge against Mr. Scott Russell's assertions, made in page 312, in the September number of the C. E. and A. Journal, is based in some degree on the unsound foundation of this difference.

The English rule for a cylinder 48 inches in diameter would be founded on two assumptions, the first, that the speed of the piston would be 220 feet per minute, and the second, that the surplus pressure on the piston would be 7·, or 7·1, or 7·3 lb. per square inch. The practice, I believe, varies within these limits, hence

$$\frac{48^2 \times \cdot 7854 \times 220 \times 7 \cdot 1}{33,000} = 90 \text{ horse power.}$$

The Scotch rule takes the actual speed of the piston per minute, and the mean pressure per square inch, and then employs 44,000 lb. as the divisor on the gross, instead of 33,000 lb. on the nett or surplus power of the steam.

The effect of this rule is an allowance of 25 per cent. of the gross power for engine resistances and friction.

Under the given conditions $\frac{11 \times 33,000}{44,000} = 10\frac{1}{2}$ lb. is the surplus steam pressure taken, instead of 7·1 lb. the assumed pressure by the English rule.

If a question had arisen, which rule is preferable, that adopted in the Clyde is, I conceive, superior in every point, especially in the closer approximation given of the real engine resistances.

We have however to deal with Mr. Scott Russell's assertions; that the Flambeau, built on the wave principle, "with the smallest proportion of power to tonnage, and smallest supply of steam, is nevertheless the swiftest vessel on the Clyde."

The assertion of greatest speed obviously referred to last season, and is granted to be correct. The least steam assertion is in fact granted by the account of the change of the boiler, but the effect of a new and probably heavier boiler is curious, and an accurate statement of the facts would be valuable. On the estimate of horse power here given, as the Flambeau is 280 tons, we have $\frac{280}{90} = 3$ tons per horse power.

Is the assertion of less power in proportion to tonnage correct or not, on this estimate? (Clyde boats are notorious for power in proportion to tonnage, an opinion due I conceive to the rule of horse power used on that river)—other boats of course being estimated in the same mode—however I should prefer a comparative estimate of both by the Clyde rules; and it would be extremely interesting, if accompanied by the dimensions of the steam boats, and of their engines, with other particulars; for though the public may but slightly regard questions relating to Mr. Scott Russell's figures, yet the success or failure of the Wave principle applied to ship building will and ought to command attention, provided satisfactory data can be supplied.

However desirable an uniform method of calculating horse power may be, yet its general adoption will be prevented, by the wish of each party to impose their own rule on others; but the fact of an existing difference cannot be too strongly brought before the public, as a decided demonstration of opinion on their part could alone compel manufacturers to adopt a decent degree of uniformity in the method of estimating engine power. Argument will be of no avail in cases of this character, where interest, or supposed interest interferes, still a steady exposure of all attempts to exalt or depreciate engines, or steam boats, when founded on the unsound basis of a difference of horse power rules will tend towards the desirable object, of producing uniformity.

I remain, Sir, your obedient servant,

Y —.

September 26. 1841.

COMPETITIONS.

Sir—An error, at least an awkward omission in the printing of my former letter will serve as excuse—if excuse be wanted—for my troubling you again, although I should hardly consider it worth while to do for the purpose of correcting it, had I not also some further remarks to offer on the subject itself. I applied the term "swindling" to the manner in which architectural competitions are frequently conducted, adding that "to give it *any softer name* would be almost to countenance it." But the words here put in italics having been omitted either by myself or the printer, the sense could be only guessed at.

I am no friend to "soft names"—to that squeamishness of language, which is unhappily so prevalent at the present day, and which designates an affair of murder "an affair of honour," and an affair of villainy "an affair of gallantry." That the *indecorous* but expressive word swindling was not at all too harsh a one is fully proved by Mr. Watson's letter, which appeared on the very same page of your Journal as my own. Nevertheless no steps of any kind seem to be adopted by the profession, in order to put a stop to the shameful abuses now practised, and reform the present juggling system of competition. As to the Institute of British Architects, they are like the Gods of Epicurus, and wrapped up in their own divinity trouble themselves not with the concerns of the lower world which they leave to shift for itself as best it may. So far from coming forward with any measures of their own for correcting the present shameful or shameless system of competition, they do not even care in any way to support or aid—I might say, even to countenance aught that has been from time to time suggested as an abatement, if not a perfect cure of the evils now so frequently and so loudly complained of by the profession generally, as individuals; and which affect not only the interests of these last, but those of the art itself, converting the opportunities for advancing it into nothing better than so many jobs and jobberies. More than once before now it has been asked "what has the Institute done for the advancement of architecture?" and we are waiting for the answer. In the mean while—and a prodigiously long while it is likely to be ere that plain question can be plainly and satisfactorily replied to, I would propose in addition to the suggestions which have already been thrown out in other quarters, that in future in every competition for a building of any magnitude—say where the contemplated cost exceeds 10,000*l.*—a lithograph copy of the selected design should be sent to each of the competitors, either when his own drawings are returned or afterwards, whereas now, nothing, if it can possibly be helped, is suffered to transpire relative to the one approved of and adopted,—or possibly, adopted without any grounds of approval or preference being assigned, supposing it were possible to do so.

As an instance I will mention the Camberwell Church Competition, for which I saw one or two sets of drawings before they were sent in, and for one of which in particular I anticipated success,—that is, supposing matters were to be managed fairly, and that success was to depend upon the merit of the design. The result, however, has contradicted me, yet it is exceedingly doubtful to myself whether the one chosen be at all better, or even so good by many degrees. Be it what it may, no one as far as I can learn seems to know what it really is,—not even those who measured their strength against the successful candidates (Messrs. Scott and Moffat) and who consequently are rather interested in ascertaining the quality of their design. Now I conceive such a regulation as that above suggested would be a very wholesome one. It would effectually remove the appearance of skulking mystery that is now allowed to hang over competitions. It would at any rate be some pledge on the part of those who selected the design, that they had confidence in its merits. Yet for this very reason, perhaps, it is most unlikely that such measure should be adopted by the "Great Unknown" behind the curtain. It must therefore be forced upon them,—and it can be done by no others than the profession themselves, who might if they pleased make a law among themselves to such effect. At any rate so long as they take no steps whatever to correct the abuses now practised with impunity in competitions, they have no very great right to complain of them. Let them join in a body and defend their own interests. Or are we to imagine that the majority of them are rogues, and consider it their interest to uphold the present corrupt and absurd system of Competition?

Vindex.

ADVICE TO PUPILS.

[The accompanying letter has been forwarded to us by a correspondent; it was written by an engineer of considerable experience to his son, a youth of 17 years of age; we consider that the sound practical advice it contains should be read by all young men entering the engineering profession, and we feel much pleasure in publishing the letter verbatim.]

Dear Son—Yours of the 19th I duly received, you inform me that Mr. B. has appointed you to superintend the bridges, on a certain railway. Now my advice is, adhere strictly to the directions of the specifications and drawings. If you feel yourself at a loss to understand thoroughly, (but first of all spare no pains in studying them,) by all means see or write to Mr. B., "not any one else by any means." I am quite sure he will feel it a great pleasure to explain any part or portion to you: but always remember Mr. B. first. Never consult any one, or give your opinion on the subject: what you speak, or explain, let it be the words, or parts of the drawings, specifications, or your instructions: and be sure always to act up to your instructions, with firmness. Never conceal any thing from Mr. B. in any shape respecting the works, for there is nothing so bad. I am perfectly aware that when any portion of the works does not come together, or remain firm as it was at first intended, the fault generally occurs in the commencement, or during its progress, by the superintendent's oversight, or fear of asking his employer; by this neglect the work is condemned; your employer is brought into contempt; and the superintendent is discharged: and all this happens, because the superintendent did not like to see trouble, or explain the faults to his employer; but will sooner give way to some foreman or workmen, and hide his or their mistakes. "Always remember and bear in mind this one thing, let your employer's duty be such to you, that you will *stand* or *fall* by, or with *him*." I am quite aware that you will find enemies for a while, but when they find that you will not deviate, (for depend on it, there is but the right way,) they then will give way and be reconciled, although perhaps against their will. Never be afraid of stating the plain *facts*, for by so doing your employer is on his guard; and then he has it in his power in time to proceed in that way which seems most prudent to him, and the safety of the work. The next thing I wish to call your attention to is, you will be sure to meet with persons on and off the works, (and perhaps some of them have great interest in the work), that will ask you many questions, and also your opinion about the works; and it sometimes occurs they will be questions which they are ashamed to ask your employer. Now in respect to these points be very much on your guard. In the first place you have no opinion to give, your place is to see the work performed agreeably to your instructions; and, in the next place, always have something in hand; for generally speaking, those characters do not address themselves to industrious persons; and if pressed hard on the subject, you can say I will ask Mr. B. if they think proper; but above all, every person must be respected agreeably to the station he holds. Every one, both *they* and *you* must know your stations. Be free and pleasant to all, but all must know their places, and every one must be kept there.

To conclude this advice, I am quite sure if servants would act straight forward with their employers, and be ready to *stand* or *fall* by them, (be sure to understand me clearly, I abhor tale-bearers,) their employers would not experience so many anxious hours; perhaps I should not be wrong if I were to say *days* or *weeks*, respecting the progress, and the ultimate safety of the works.

Now in respect to the works themselves, if it be wood-work. If there are any longitudinal beams or bearers, and they require bolting together to obtain sufficient strength, always prefer those pieces that have a camber or circle. Then by placing the inner circle of one on the outer circle of the other, you will find the beams will bear a greater burden than two straight ones. Again, never permit any sap to remain in that portion of the timber which is jointed together, for in a short time that will decay, bolts will be of no service, and the work will fail. If timber cannot be obtained without sap, let that portion be placed where it can be seen and repaired, and then it will not injure the work. Again, wherever timbers joint, bear, or overlap each other, be sure those joints, &c. are firm, square, and well put together.

Again, in respect to bolts, see that the heads are well welded on, also the nuts well cut and fitted, and the nut and head in proportion to the size of the bolt. Then again, in bolting timbers together, see that the holes are straight, for a bolt cannot be so strong if it be not straight. Again, never permit the bolts to be driven with an iron hammer, (a wooden one is best,) for it often happens that when the head comes in contact with its situation, off it goes, or almost off. (Then where is the strength? *why, it is lost.*) Again, in preparing the wood work, always have by the men a few temporary bolts, do not use your permanent bolts for every thing. Again, never permit your bolts to be longer than necessary (and also not too short), for when the work is finished, and one bolt is longer than another, it appears the superintendent had no eyes, and also it is a waste of money. Again, I find in bolting up the work, washers under the nuts are much required, for it is almost impossible to get work *firm* and *solid* without them. Also be very careful in the selection of your materials (if timber); suppose for instance, you require 20 pieces, and they be one inch longer than required, (there is 20 inches waste), the carpenter will say it is only one inch, but I do assure you, if your employer had a sack full of money, a careless servant will soon make him find the bottom of it. I am aware many will at times make many shifts in carrying on works, but if carried too far, it is *waste*: men cannot do their duty without materials, but if used too freely, then there they make *waste*. This case I consider will answer in every department. Now in respect to men, endeavour to obtain that price for their labour which is correct; also in keeping their time, or measuring their work, be *just*—never *give* nor *take*. Let them be paid for what they work and no more; for if once you go beyond that mark the man is never satisfied, either with his *work*, *money* or *master*. I also beg to state, that in carrying on and at the finish of the works, always keep them in a clear and comfortable state; then materials do not get buried up and wasted, the men are enabled to go forward with their work to much greater advantage, and also your employers can examine and inspect the work with that ease and pleasantness which should always be considered by a superintendent towards his employer. I know it will remove many anxious thoughts and unburden the minds of those above you, in passing your portion of work, after viewing the careless scenes and ways of others.

I remain, your affectionate Father,

* * * *.

VENTILATION OF THE NEW HOUSES OF PARLIAMENT.

REPORT BY THE LORDS' SELECT COMMITTEE.

That the committee have met and considered the matter to them referred, and have examined witnesses thereon, and have come to the following resolution, viz.:—

"Resolved, that it appears from the evidence of Mr. Barry, that the only expense necessarily to be incurred in the course of the next six months, with the view of making preparation for the adoption of the plans prepared by Dr. Reid, for ventilation of the new Houses of Parliament, by means of a central tower, consists in strengthening the foundation of the central saloon; that under these circumstances, and adverting to the fact, that according to the evidence of Dr. Reid, he is still engaged upon a course of experiments upon the subject of the ventilation of the Houses of Parliament, it appears to the committee that it is not necessary to come to a final decision upon the matter referred to them before the next session of Parliament."

That the committee recommend in the meantime that authority be given to Mr. Barry to increase the strength of the foundation of the central saloon, as adverted to by Mr. Barry, in case it should be found necessary, before the next session of Parliament, to proceed with the foundations of that part of the building.

October 1, 1841.

Their Lordships examined only two witnesses—Dr. Reid, and Mr. Barry, the architect. The following are extracts from the evidence:—

The Lord President in the chair (Sept. 27).

David Boswell Reid, Esq., M.D., examined.

Do you think it desirable to carry the air from the new houses of Parliament through one chimney in the manner which has been proposed?—I do.

Will you explain the course which the air would take in passing through the buildings, and the way in which you propose to manage it?—This is a general illustrative section (producing a section), intended to represent the principle, not the details. We find that the air as it is discharged generally from various altitudes in London passes horizontally much more frequently than in any other direction; hence, if there was a considerable discharge of foul air from any chimney or shaft, either from the houses or the neighbourhood, it might enter at one part of the building but not at another; it is accordingly recommended that there should be two openings provided for the ingress of fresh air, so that if the external air were blowing in one direction, and the foul air being discharged in the same line, one of these might be shut, and the other being opened we should have a purer atmosphere introduced, while at the same time the natural force of the wind filling with a plenum movement all these chambers below, and there tending to pass into all the several apartments from this reservoir in the basement, and having been led subsequently into the individual apartments, its entrance into each of those being regulated by valves, its own ascending power, arising from the heat communicated to it, would not be lost, but added, as it were, to the original impetus communicated by the wind, and tend to convey it from each individual apartment till it all centred in this large shaft; so that were this shaft adopted, or any central discharge equivalent to it, there would be at all times and seasons a power of movement upon the atmosphere throughout the whole of the buildings which would perpetually renovate the air, whether machinery were employed or not. But it is considered desirable (more especially since I have seen at the bar of the House of Lords fully nine members of the House of Commons upon every square yard—that is, a man to every foot), in order to check and prevent entirely the draughts which under those circumstances are apt to be perceived if a sufficiency of air be introduced, to assist from time to time a mechanical power whenever the apartments are crowded, by placing machinery under the central hall; so that even on those days when the air is dull and sluggish, from a similarity of temperature within and without, this moving power may be brought into operation in supplying the proper quantity of air without incurring the risk of partial draughts at the doors. Further, it has been recommended strongly, that while fireplaces may be introduced in the individual apartments, still it would be important to warm the air generally in the centre, which may be considered the heart of the building; so that, instead of local currents flowing unequally, there would be a general warmth communicated to the atmosphere of the whole building, so as to sustain not only the apartments but also the passages at a comparatively uniform temperature. It has further been suggested, connected with the general outline represented here, that smoke might be entirely avoided were particular kinds of fuel adopted which are quite competent to produce a cheerful and agreeable-looking fire, as I am prepared to demonstrate by models, and also by fireplaces which have been constructed for the purpose, the flues being led from each individual apartment and being carried into fireproof channels communicating with the central shaft. Then the risk of fire would be very much avoided, and all sweeping would be rendered unnecessary, for which there is a very considerable expenditure annually even in the present buildings; and at the same time, while comparative security from fire and general ventilation would be attained, there would be a complete and entire prevention of all return of smoke, or even where no visible smoke was produced, all return of foul air from the chimnies would be utterly and entirely averted, from the certainty of discharge insured by the power of draught in the central shaft.

Suppose this to be the east and that to be the west, if the wind is in the east you bring the air in here by this valve, and you shut the other valve?—Yes.

Then the air coming in here, you bring it to that point, and it expels the foul air up this chimney?—It does. I would beg to add, that since I had any thing to do with these houses I have sometimes found that the demand for air is exceedingly great. On the late occasion, when Parliament first met, which is the first time that there have been crowded houses in the autumn, so far as I have had an opportunity of observing, we found that 50,000 cubic feet per minute was far too small: in both houses they called for a larger supply of air; and I was obliged to put on additional power by the action of heat, which increased the supply to about 70,000 cubic feet per minute. Now, the observation I wish to connect with that is simply this, that if the pure air be driven down into those vaults below which have been left expressly for this purpose, then, during warm and oppressive weather, we shall not only be able to obtain air of comparative purity, but we shall also have the power of cooling this atmosphere in those extensive vaults, which will warm the air as much in winter as they will cool it in summer.

Would it be possible to apply this method of letting in the pure air and driving out the foul air only to the Houses of Lords and Commons, without extending it to the other apartments, and would that decrease the expense very considerably?—It would certainly decrease the expense considerably, but I should question whether it would increase the comfort, or whether it would diminish the annual expenditure. After the experiments which I made with 100 people in an apartment constructed expressly for this purpose, I found that the great difficulty in all cases of ventilation was, that when a great amount of air was required, when a number of individuals sat within a certain space, there were sensible currents. This led me to the idea of universal diffusion in introducing the air, which forms the principal peculiarity of my plans; but in adapting that universal diffusion to the new houses it occurred to me that if certain arrangements are permitted connected with the mode of placing the seating, the same extent of diffusion might be obtained without the risk of any portion of the air coming through a part of the floor on which a foot had trod. I would also beg to be permitted to say another word upon this point, namely, that even with universal diffusion it is difficult to reduce sensible currents. It is found that in this city there is a difference of temperature extending to a range of 35 degrees as far as different individuals like or dislike the atmosphere introduced. An average, therefore, only can be attained under such circumstances: and in endeavouring to attain this, and knowing the desires and requests which are continually urged upon those who are in attendance for the purpose of regulating the state of the atmosphere, I think I have at last ascertained that by introducing air in large quantity, and at a more elevated temperature than is generally given, there is less dissatisfaction connected with the amount of supply than in any other way. * * *

Are you aware that frequently peers have been obliged to leave their seats on account of currents of air that came in at the back of the neck?—I have been informed that they have; and I attribute this to the conflicting opinions entertained by different peers as to the amount of supply required, for the force of these currents can be checked in an instant, to any amount, by the present arrangements, were instructions given to that effect. It frequently happens that the most opposite demands are made at the same moment. I may also be permitted to state, that when the alterations in the House of Lords were introduced I was limited to a given sum before any estimate was made, the committee considering it not desirable to expend a larger sum when they had the prospect of occupying the new houses in a few years. At the time that sum was allowed I represented at the Office of Woods that it would be desirable to make some addition to it at all events, which was agreed to as I represented, as I was afraid I should do more harm than good if some increase was not allowed; but it was impossible with the sum that was granted to put it exactly upon the same footing as the House of Commons.

Supposing that the committees of the houses of Parliament were to decide against having this great tower or spire, in what way would you then propose to conduct the ventilation?—I should propose under those circumstances to retain everything else as it is represented, but to have the moving power here (pointing to the machinery under the central hall) increased to such an extent as to possess an equivalent power to the total discharge of the shaft. In the plan contemplated the moving power is proposed to be the shaft, conjoined with machinery to be used on particular occasions; then, if the shaft be dispensed with, it would be necessary to increase the moving power.

Mr. Charles Barry examined.

You are aware of the plan which has been proposed by Dr. Reid for the purpose of ventilating the new Houses of Parliament, and the buildings generally?—I am quite aware of it.

And you have prepared a plan with reference to it?—I have.

Dr. Reid having stated the advantage of a central egress for the air, you have prepared a drawing of an addition to the building in the centre for that purpose?—I have.

How high is it to be above the roof of the present building?—The height above the central hall of the intended building will be 150 feet to the aperture beneath the spire.

Then is all above that solid masonry?—No; it would be hollow, and might be pierced for the egress of air. There would be no difficulty in making the spire available for the egress of air, as well as the louver beneath it.

Would there be any necessity for this addition of the tower for any other purpose but for the ventilation of the houses?—There is not any positive necessity for it, except for the purpose of carrying into full effect the proposed system of ventilation.

But there is no other reason why you would wish to have this additional building?—I cannot say that there is no other reason, because I think that the addition of a tower to the intended building, in the situation and of the form proposed, would enhance considerably the importance and picturesque effect of the mass, and, therefore, upon that account I should be anxious to have it adopted.

Have you made an estimate, and are you therefore enabled to state what the additional expense would be of the erection proposed for the purpose of ventilation, independently of the fire-proofing and the apparatus?—Independently of the fire-proofing, the expense of the ventilating tower would be 20,000*l.*, of which about 8,000*l.* or 10,000*l.* may be considered for external decoration.

Under any principle of ventilation, supposing several egresses to be made in different parts of the building, it would be equally necessary to have flues for that purpose?—Certainly.

Therefore the whole sum of 86,000*l.* is not fairly attributable to the tower alone?—Certainly not; only 20,000*l.* of that amount is applicable to the tower.

Therefore the increased expense of the proposed tower, beyond the expense of ventilating by means of several egresses, would be only 20,000*l.*?—That would be the actual cost of the tower itself; but if Dr. Reid's system of warming and ventilating should be adopted, the difference in the cost occasioned by the central tower would be about 10,000*l.*, as in case of dispensing with it other works would be necessary, the cost of which would be above 10,000*l.*

That is including the provision of making the whole of the floors fire-proof?—Yes. The estimate of 86,000*l.* includes the cost of the works which are necessary to render the entire building fire-proof.

What part of the building was originally intended to be fire-proof?—The whole of the public rooms of the building were intended to be fire-proof, such as the two houses, the committee rooms, the libraries, &c., as well as the whole of the basement and ground floors, but not the official residences.

Was the roof intended to be fire-proof?—No; the roof is proposed to be framed of timber in the usual way.

Is this system of ventilation intended to apply to the official residences as well as the committee rooms and the houses themselves?—I understand so.

ON FRESCO PAINTING.

By C. Eastlake, R.A.

The present German School of Fresco Painters has been formed within the last 25 years. Its first essays, to which I have alluded, were in a great measure the result of a general spirit of imitation which willingly adopted all that was associated with the habits of the latter middle ages. It may be as well to review the origin and progress of this state of feeling in the present century. The historians of modern German art have indeed traced its rise to earlier influences, but all agree that the circumstances to which we are about to refer greatly promoted the introduction of a new taste in painting.

The efforts to create a new style of art, in Germany, in the beginning of the present century, were intimately connected with the struggle for political independence. The cathedrals and churches on the Rhine had been more or less desecrated and plundered, and the pictures by the early German masters dispersed and sold. The gradual recovery of these ended in the formation of collections of such works; this led to a higher appreciation of their merits, indulgently seen as they were by patriots anxious to restore and maintain all that especially characterized the German nation. With men thus inspired, the connexion of such feelings with the religion of their forefathers was obvious. German artists and writers again, who visited Italy, dwelt on the relation that had subsisted between Germany and Italy before and since the revival of letters, not only in politics but in the arts. The Tower at Pisa, the church of St. Francis at Assisi, and other buildings, had been erected by Germans, and it was remembered with pride, that the new life of Italy had been kindled chiefly by the genius of the northern nations. The spirit of the middle ages was thus in a manner revived, and the Germans looked with complacency on that period when the Teutonic nations, unassisted (as they assume) by classic examples, produced a characteristic style of architecture, and developed their native feeling in the arts of design and in poetry. In those ages, architecture, the most necessary of the arts, and therefore the first in date, had time to develop itself fully, especially in the north; but before painting could unfold itself in an equal degree, the thirst for the revival of classic learning and the imitation of classic models prevented the free formation of a Christian and national style. The early specimens of art which were most free from this classic influence were thus regarded with higher veneration, and the Germans of the 19th century boldly proposed to throw aside all classic prejudices, however imposing, and follow up the imperfect beginnings of the latter middle ages in a kindred spirit. This general aim connected the early efforts of Italian art still more with those of Germany, and the German painters who visited Italy, recognized the feeling that inspired them in all works which were supposed to be independent of a classic influence.

The degrees in which this spirit has prevailed have naturally varied. With many, the imitation of the earlier masters soon gave place to a juster estimate of the general character of the art. The antique has even, to a certain extent, reassumed its empire; but on the other hand, some of the best German artists have unflinchingly maintained the general principles above described, even to the present day; indeed not a few had at first returned to the old faith, and had imbibed with it a still deeper attachment to the spirit of the early painters.

It is necessary to bear these facts in mind, in order to understand the particular aim which many (perhaps the best) of the German artists have in view. The veneration for the general spirit which prevailed at the revival of art was accompanied by an imitation of the characteristics and even the technical methods of the early painters; the habits and the productions of mediæval Italy were, as we have seen, easily associated with German feelings, and to this general imitation the adoption of fresco painting is partly to be attributed, though that art was never before practised by the Germans. Fresco painting was, in short, only one of many circumstances which had acquired interest and importance in the eyes of German painters from the above causes. The predilection for the early examples of Christian art did not exclude the study of better specimens created in the same spirit, but the indications of a classic influence were sufficient to condemn the finest works, and hence the later productions of Raphael were not considered fit models for study.

Let us now consider how far we, as Englishmen, can share these feelings and aims. If the national ardour of the Germans is to be our example, we should dwell on the fact that the arts in England under Henry the Third, in the 13th century, were as much advanced as in Italy itself; that our architecture was even more characteristic and freer from classic influence: that sculpture, to judge from Wells Cathedral, bid fair to rival the contemporary efforts in Tuscany, and that our painting of the same period might fairly compete with that of Siena and Florence. Specimens of early English painting were lately to be seen—some very important relics still exist on the walls of the edifices at Westminster. The undertaking now proposed might be the more interesting, since, after a lapse of six centuries, it would renew the same style of decoration on the same spot. The painters employed in the time of Henry the Third were English; their names are preserved. Thus in doing justice to the patriotism of the Germans, the first conviction that would press upon us would be that our own country and our own English feelings are sufficient to produce and foster a characteristic style of art; that although we might share much of the spirit of the Germanic nations, this spirit would be modified, perhaps refined, by our peculiar habits; above all, we should entirely agree with the Germans in concluding that we are as little in want of foreign artists to represent our history and express our feelings, as of foreign soldiers to defend our liberties. Even the question of ability (although that ability is not to be doubted for a moment) is unimportant; for, to trust to our own resources should be, under any circumstances, the only course. Ability, if wanting, would of necessity follow. Many may remember the time, before the British army had opportunities to distinguish itself, when continental scoffers affected to despise our pretensions to military skill. In the arts as in arms, discipline, practice, and opportunity are necessary to the acquisition of skill and confidence; in both a beginning is to be made, and want of experience may occasion failure at first; but nothing could lead to failure in both more effectually than the absence of sympathy and moral support on the part of the country. Other nations, it may be observed, think their artists, whatever may be their real claims, the first in the world, and this partiality is unquestionably one of the chief causes of whatever excellence they attain. It is sometimes mortifying to find that foreigners are more just to English artists than the English themselves are. Many of our artists who have settled or occasionally painted in Italy, Germany, Russia, and even in France, have been highly esteemed and employed. The Germans especially are great admirers of English art, and a picture by Wilkie has long graced the Gallery of Munich.

If, however, we are to look to the Germans, the first quality which invites our imitation is their patriotism. It may or may not follow, that the mode of encouraging native art which is now attracting attention at Munich is fit to be adopted here. We have seen that a considerable degree of imitation of early precedents is mixed up with the German efforts; this of itself is hardly to be defended, but the imitation of that imitation, without sharing its inspiring feeling, would be utterly useless as well as humiliating. The question of fresco painting is in like manner to be considered on its own merits, without reference to what the Germans have done, except as an experiment with regard to climate. The fresco painters of Munich generally work on the walls from May to September only; the greater part of the year is thus devoted to the preparation of the cartoons. Five months in the year would probably be the longest period in which it would be possible to paint in fresco in London. But assuming the new Houses of Parliament to be thus decorated, and that the works could not be completed before the rooms would be wanted, the paintings could be continued annually in the autumn without inconvenience. The climate of England and Germany might in some respects be more favourable to the practice of fresco than Italy. The surface of the wall is in the fittest state to receive the colours when it will barely receive the impression of the finger (when more moist, the ultimate effect of the painting is faint); this supposes the necessity of a very rapid execution in a warm climate, where the plaster would dry more quickly.

Fresco painting, as a durable and immoveable decoration, can only be fitly applied to buildings of a permanent character. Not only capricious alterations, but even repairs cannot be attempted without destroying the paintings. There can be no doubt that the general introduction of such decorations would lead to a more solid style of architecture; at the same time the impossibility of change would be considered by many as an objection. This objection would not, however, apply to public buildings. In case of fire, frescos would no doubt be more or less injured or ruined, but they might not be so utterly effaced and destroyed as oil pictures in the same circumstances would be. On the whole, the smoke of London might be found less prejudicial than that of the candles in Italian churches. The Last Judgment of Michael Angelo could hardly have suffered more in three centuries from coal fires than from the church ceremonies, which have hastened its ruin. The superior brilliancy (looking at this quality alone) of frescos which adorn the galleries of private houses, where they have not been exposed to such injurious influences, is very remarkable; as, for example, in the Farnese ceiling. The occasional unsound state of some walls, even in buildings of the most solid construction in Rome, is to be attributed to slight but frequent shocks of earthquake. A ceiling painted by one of the scholars of the Carracci in the Costaguti Palace in Rome, fell from this cause. Such disadvantages might fairly be set against any that are to be apprehended in London. With regard to the modes of cleaning fresco, the description of the method adopted by Carlo Maratti in cleaning Raphael's frescos when blackened with smoke happens to be preserved; but no doubt modern chemistry could suggest the best possible means.

The general qualities in art which fresco demands, as well as those which are less compatible with it, have been already considered. It may be assumed that it is fittest for public and extensive works. Public works, whether connected with religion or patriotism, are the most calculated to advance the character of the art, for as they are addressed to the mass of mankind, or at least to the mass of a nation, they must be dignified. Existing works of the kind may be more or less interesting, but there are scarcely any that are trivial or burlesque. This moral dignity is soon associated in the mind of the artist with a corresponding grandeur of appearance, and his attention is thus involuntarily directed to the higher principles of his art. In my evidence, I expressed the opinion that although a given series of frescos must be under the control of one artist, it would be quite possible to combine this very necessary condition with the employment of a sufficient number of competent artists by subdividing the general theme. Thus, if we suppose the general subject to be Legislation, it might combine the symbolic and dramatic styles, and even subjects of animated action. It might be subdivided, for example, into the history and progress of legislation, founded on religion and morals, and producing its effects in peace and war; exemplified in the one by industry and commercial enterprise, in the other by instances of the courage which results from a due appreciation of national benefits, and the feelings of loyalty and patriotism. Any subject of great and universal human or national interest might be made equally comprehensive. It has been assumed that the practice of fresco would be beneficial to English artists technically; we proceed to consider how it would affect them in other respects.

The painters employed on an extensive series of frescos would have to devote a considerable portion of their lives to the object. Such an undertaking would require great perseverance on their part. It is needless to say that they ought not to encounter any impatience or want of confidence on the part of their employers: the trial should be a fair one. It would hardly be possible for the artists to undertake any oil pictures while so employed, and I confess I have some fears that, when debarred from the exercise of oil-painting, and confined to a severer and drier occupation, they might find their task irksome. One of the first artists at Munich, in writing to me not long since, said he sighed to return to oil-painting. If the German fresco painters can feel this regret at giving up their first occupation, for so many years, it may be supposed that the English artists would experience such a feeling in a greater degree. When the King of Bavaria honoured me with a visit in Rome, he told me he had made an arrangement with Schnorr, and had given him employment in fresco for ten years: that excellent artist has now been occupied at Munich in public works for a much longer period. No hopes could be held out to the principal painters that they would find time for oil-painting as well, for their designs and cartoons would take up all their spare time. After a few years, when assistants were well formed, more leisure might be gained, and it was under these circumstances that Raphael painted in oil when employed by Julius the Second in Rome; but for the first three years after he began the frescos in the Vatican, he confined himself entirely to those labours; and Michael Angelo, as is well known, painted the ceiling of the Cappella Sistina alone.

The more general practice was however to employ assistants, and this is one of the serious considerations connected with the present inquiry. Owing to the self-educating system of painters in this country, the younger artists are more independent than they are elsewhere, and they might have some reluctance to co-operate in works in which their best efforts would only contribute to the fame of the artist under whom they worked. In Italy, and in recent times in Germany, this subordination was, however, not felt to be irksome, and the best scholars were naturally soon intrusted with independent works. It is possible the talents thus created would be employed to decorate private houses, but the Government would incur a sort of obligation not to leave a school thus formed unemployed, especially as the artists, from want of practice, might be less able to cope with those who had been exclusively employed in oil-painting. The result, however, might be that the school would gain in design, at some sacrifice of the more refined technical processes in colouring, in which the English painters now excel their Continental rivals. It is true some Italian painters, for example, Andrea del Sarto, the Carracci and their scholars, were equally skilful in oil and in fresco. The earlier masters were, however generally stronger in the latter; and Sir Joshua Reynolds observes that Raphael was a better painter in fresco than in oil.—*Athenæum.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

May 11.—*(continued.)*

"*Experiments on the strength of Brick and Tile Arches.*" By Thomas Cubitt, Assoc. Inst. C. E.

In the course of his extensive building engagements, the author had occasion to construct some fire-proof floors: he therefore wished to ascertain how the greatest amount of strength could be attained, with a due regard to the space occupied, and the cost of the structure.

Two arches were built, each with a span of 15 feet 9 inches, and a rise of 2 feet.

The brick arch was 2 feet wide, and composed of half a brick in thickness, with cement.

The tile arch was 2 feet 4 inches wide, and built of 4 tiles, set in cement, forming a thickness of $4\frac{1}{4}$ inches.

The spandrels of the arches were filled up level to the crown with rubble work and cement. A load of dry bricks was placed along the centre of both arches, and gradually increased at stated periods, from 12 cwt. 3 qrs. up to 160 cwt. at the end of 75 days, when the abutments of the brick arch gave way; and the tile arch broke down while loading.

The deflection at three points is given in a tabular form; and although, from the circumstance of there having been no tie bars across the arches, the experiments cannot be considered satisfactory, they are valuable, as supplying data hitherto rarely recorded.

Drawings of the arches accompanied the paper.

"*Description of a Stone Bridge on the Middlesborough Railway.*"—By John Harris, M. Inst. C. E.

The bridge described in this communication is only remarkable for the flatness of the arch, the rise being 5 feet for a span of 30 feet.

A drawing, and the specification of the cost of the work, with a schedule of prices, accompanied it.

"*Description of a Bridge built of Blue Lias Limestone, across the Birmingham and Gloucester Railway at Dusbampstead.*" By Captain James Vetch, Assoc. Inst. C. E.

The peculiarities in the construction of this bridge are, that the arch was composed of very small stones of the blue lias limestone, from three to five inches thick, and squared to about nine inches long and broad; that it was erected without the usual timber centreing, and that the mode of removing the earth centreing precluded any danger from unequal sinking in the arch. The span of the bridge is 60 feet, with a rise of 10 feet. The material of the cutting where the bridge is situated, consisted of weak slate and clay, consequently the mode of construction was subjected to a severe test. The abutments being completed to the springing height, the ground was cut away roughly to the form of the arch; seven rows of pegs were then inserted with their upper ends correctly designing the proper curve; a line of planks 3 inches thick was laid transversely beside each row of pegs, and upon them were placed lines of battens on edge, gauged to the exact profile of the bridge; the earth was consolidated, and a flooring of battens laid over all to form a true bed for the soffits to rest upon. From the absence of parallelism in the lias stones, their varying thickness, and the difficult adhesion of the mortar, it was deemed necessary to introduce seven transverse bonds of free-stone, which imparted to the whole structure a tendency to settle in the lines of the radii of the arch, and also prevented any rent in the lias masonry from proceeding to a dangerous extent; these free-stone bonds were firmly fastened with iron cramps. The face had a batter of 1 in 9, from the springing to the string course, in order to counteract any tendency to bulge towards the faces, or in the line of the least resistance. The base was also extended and the crown narrowed, which gave a concave form to the string course. The whole arch being filled in with the full depth of stone work on each springing, and the bonds of free-stone all placed, the lines of each between the second and third bonds were keyed up, and then those between the third and the centre bond, which thus apparently formed the key stone.

The earth centre was removed by cutting a heading 4 feet 6 inches wide, directly beneath the key stone, and then gradually excavating on either side uniformly towards the abutments, stopping at certain intervals to allow any settlement to take place. By proceeding thus, as successive portions of the arch were left to their own bearings, regular compression ensued, and a small portion only of the work was exposed to the risk of fracture from inequality of pressure; the rising of the haunches which generally accompanies any undue depression of the crown, appeared by this method to be entirely avoided.

The author ascribes much merit to the careful manner of keying in the courses, as no cracks occurred, and the settlement of the arch did not exceed 2½ inches. He conceives this experiment to have answered completely, as there was a saving of time, the expense of erecting the usual wooden centre was avoided, and the bridge was ready when the railway cutting reached it. He considers that this system may be advantageously used in many situations upon railways, and that the span may be at least double that of the bridge now described.

The communication was accompanied by three drawings, showing the details and progress of the construction.

"*Description of the great Aqueduct at Lisbon, over the Valley of Alcantra.*" By Samuel Clegg, Jun.

This aqueduct was founded by king John the Fifth in 1713, and completed by the Marquis of Pombal, 1755. It resisted uninjured the shocks of the great earthquake in that year, although it was observed to oscillate considerably. The most conspicuous part of the work is that which crosses the Valley of Alcantra; it consists of 32 arches, with spans varying from 50 to 105 feet; the crown of the centre arch is 225 feet from the ground. The length of this portion is 3000 feet.

The sources from which the supply of water is derived, are situated in the high ground in the neighbourhoods of Cintra and of Bellas—they are eighteen in number; one of these tributaries is conveyed by a culvert from a distance of 15 miles. The main duct into which the tributary streams empty themselves, forms a tunnel of 6 feet wide, and 7 feet high, ventilated by vertical shafts, at distances of a quarter of a mile apart. The channels for the water are made with "drain tiles," 12 inches wide and 9 inches deep, open at the top. After passing over the great aqueduct, the main duct runs under ground for half a mile, is carried across the "Estrada do arco Cavallo" on seven arches of 40 feet span each on the south side of which it continues beneath the surface until it reaches the aqueduct of "Agua Livres" in Lisbon, and empties itself into the reservoir at its termination.

This reservoir is 60 feet long, by 54 feet wide and 27 feet deep. The quantity of water contained in it when the author took the measurements was 64,800 cubic feet. He was unable to obtain a section of the retaining walls, but supposed them to be about 23 feet in thickness.

The pipes through which the water is distributed to the neighbouring fountains are of earthenware and stone set in mortar. The velocity of its flow through the main duct is 75 feet per minute. The quantity discharged is about 73,000 gallons in 24 hours during the winter months.

Construction.—The particulars relating to the construction of the aqueduct, the author translated from the documents preserved at the office of Public Works in Lisbon. The foundations were laid in May 1713, and the piers, which in common with the rest of the work are of gray marble, carried up without footings. They are faced with ashlar work in courses from 1 foot 6 inches to 2 feet deep. The stones are dowelled together with bronze and iron; the centre portion of each pier is filled in with rubble masonry to within 30 feet of the top, above which it is left hollow. The voussoirs of the principal arch, to which the author more particularly refers, are carefully jointed, their thickness being on an average 8 feet at the springing, and 5 feet on the square at the crown. The figure of the arches is pointed Gothic, the rise being $\frac{1}{18}$ of the span. The spandrels are of closely jointed ashlar work, about 2 feet 6 inches in thickness. The backings are filled in with rubble quite solid; nor is there any provision made for the drainage.

The mortar used was made with lime from the gray marble of the neighbourhood, and sharp sea sand, in the proportions of one of the former to four of the latter.

Mode of raising the materials.—No mechanical contrivances were used for hoisting the blocks of marble, but they were slung upon poles from men's shoulders, and carried up a series of inclined planes to the height required. Some of these blocks weighed upwards of three tons. The scaffolding and inclined planes erected round the piers were of a very substantial description. The lower parts were trussed framings formed of double Riga or Dantzic timbers 15 inches square, fastened together with trenails of teak and chesnut. The inclined planes had a rise of about 1 foot in 6 feet, with a level space at each end of the pier to serve as a resting place, where a separate gang of men received the stone block, and relieved the others. The ends of the upright timbers of the scaffolding were not suffered to be surrounded by earth or moisture, but were placed upon blocks of stone bedded firmly and evenly upon the rock, and kept well tarred. The struts and braces retaining them were also secured from decay in the same manner. These precautions were necessary, not only from the great weight they had to support, but from the length of time they remained in use—not less it is supposed than thirty years.

The centreing for the arches was constructed by an Italian architect named "Antonio Davila." The arches were commenced from each side of the valley at the same time, and a temporary gangway erected over them as they proceeded, so that the inconvenience of raising the material from the bed of the valley was avoided. The centreings were framed in their places. The cradles which supported the bearing timbers of the lower truss, were morticed into sleepers resting upon projecting stones left for the purpose; those on the same pier were secured by cross timbers so as to balance each other. The lower framings were first fixed and secured by straining pieces, and the upper portion erected afterwards in the manner of a roof principal. All the scarfs were cut vertically, fastened by trenails of teak, and but little iron was used in any part of the structure. The striking wedges were placed under each voussoir, as in the French centreings. As the arch rose from the springing, the crown of the centreing was loaded with stones to prevent it rising, and altering the shape of the arch.

The cost of the entire aqueduct, which was about 21 miles long, with all the immediate and collateral works, and including the reservoir, was two millions and a half sterling.

The communication was accompanied by three elaborate drawings of the general construction and details of the aqueduct, with the manner of carrying the stones.

May 18.—The PRESIDENT in the Chair.

Thomas Lloyd was balloted for and elected a member.

"*On Sea Defences constructed with Peat Moss.*" By the Hon. Montgomery Stuart.

In the commencement of this communication, the author refers to the early period at which the art of reclaiming land from the sea was practised, and to the extensive districts both in Britain and on the continent, where sea defences of various kinds are constantly in course of construction. He then proceeds to detail the modes suggested by the experience of many years, and practised by him in constructing sea defences in the Bay of Wigtown, for the protection of the estate of his brother, the late Earl of Galloway. The whole of the district abounded with peat moss, possessing many properties which rendered it, independent of its cheapness, a peculiarly valuable material for constructing embankments to resist the action of the sea. Its tough fibrous nature, its elasticity, and at the same time, the rapidity with which the mass became solid, were useful qualities which he sought to take advantage of. He found also that it possessed advantages as a material for puddling; as from its absorbent nature it imbibed and retained all the moisture that approached it, and never cracked from dryness, as occurs so frequently with clay puddle. In case also of holes being made in the puddle either by vermin or external injury, they soon closed again from the elastic nature of the peat moss, and its tendency to grow together.

Uses of Peat Moss.—The author sometimes uses peat moss as a puddle between two ranges of stone walls, and sometimes as a backing instead of clay sod; but he more particularly recommends it as a backing to a stone defence parallel with the shore. For this purpose, the turf should be cut thin, placed against the bank, and the stone-work built against it; he has found this the most durable and effectual defence against the sea; the action of the waves against it even adding to its security, as from its fibrous nature it retains the silt thrown against the wall until all the interstices between the stones are completely filled, and a defence is thus formed for the wall itself by the accumulation against it. The method he employs is to build the sea-wall of rough rubble stone, laid dry, with a slope of about two to one; the peat moss backing, cut into blocks rather thicker than usual, is laid in courses well bonded and beaten together; it is thus consolidated throughout the height of the wall. Upwards of twenty years have elapsed since some of the first embankments were made on this principle; they have perfectly answered the purpose, and have been the means of effectually reclaiming a great extent of valuable land.

Warping silt.—The author also states, that he has lately been occupied in forming a defence, by warping silt, with whin or gorse kids, laid horizontally; a method which he prefers to that practised in Lincolnshire, where the kids are placed upright. He keeps the kids in their positions by means of stones laid on them, which are removed as the surface rises; fresh kids are then added, and the stones relaid.

The communication is accompanied by three sections of the sea defences, as they are executed, and by some corroborative testimony as to their efficiency, by Mr. Lewin, of Boston, who has examined and reported upon them. Full instructions are also given for constructing the different kinds of defences mentioned.

"*An account of the repairs done to the Beechwood Tunnel, upon the London and Birmingham Railway, September* 1840." By Thomas M. Smith, Grad. Inst. C. E.

The tunnel is built of brick, is 302 yards long, and passes through strata consisting of alternate layers of rock and marle, abounding in springs of water; it was completed at the latter end of the year 1837; that winter being of unusual severity, many of the bricks were partially destroyed, owing to their containing lime, upon which the weather acted. Mr. Robert Stephenson first contemplated applying a coat of cement throughout the inside of the arch, but it was apprehended that it would not adhere, in consequence of the constant dripping of the water. No positive steps were, however, taken until the effects of the winter of 1839-40 had so injured the brickwork as to render further delay dangerous; it was then resolved to line the whole length of the tunnel with an interior brick arch, 9 inches thick, so as to support and insure the stability of the old work.

For the purpose of executing the work with facility, all the trains of carriages were diverted upon the down line through the tunnel, and for a quarter of a mile at each end; no up train was allowed to pass upon the single line while a down train was in sight; a hoarding was then erected between the lines of railway throughout the length of the tunnel, to protect the workmen, and to prevent the building materials from interfering with the trains. The internal casing of brickwork, 9 inches thick, of English bond, was then carried up one side to the height of 4 feet 9 inches above the springing; a course of York paving $4\frac{1}{2}$ inches thick, was at this point bonded into the old work, and the new work was securely attached beneath the stone bond course by iron wedges, and regular half brick toothings were inserted, at intervals of 2 feet 3 inches apart, in chases cut into the old work; by these precautions the new work was secured from being detached, and from falling upon the passing trains.

One side being finished throughout its entire length, the trains were turned upon the up line, and the same mode of proceeding followed with the other side. A series of bearers, 6 feet apart, were then placed over head, and a close flooring laid so as to serve for scaffolding for the workmen, and to prevent the building materials from falling upon the rails. A pair of ribs were then raised upon each bearer, and keyed with a strut, 7 inches below the crown of the arch; the supporting stays were fixed, the laggans laid upon the ribs, and the brickwork of the arch was constructed in English bond throughout the whole length, and on both sides of the tunnel, simultaneously, to within 2 feet of the crown: a moveable centre, 2 feet 3 inches long, was then introduced, and the arch was closed in with two half brick rings.

The whole of the work was done with blue hard burnt Staffordshire bricks, laid in cement and sand, in equal proportions, for the side walls; for the arch, up to within 15 inches of each side of the crown, two-thirds of cement, and one-third of sand: the two rings for keying up the centre or crown were laid entirely in cement, without any mixture of sand. Previous to commencing the new work, a series of chases were made in the old wall, which, when closed in front by the lining arch, formed drains, $4\frac{1}{2}$ inches square, terminating in the culvert beneath the centre of the railway, and conveying thither all the water, which would otherwise have separated the new from the old brickwork.

This work was finished, and the scaffolding removed, within the short space of forty days, by Messrs. Grissell and Peto, under the direction of Mr. Robert Stephenson, and the immediate superintendence of Mr. Dockray.

This communication was accompanied by a drawing, showing the details of the scaffolding, and the mode of construction.

"*On the formation of Embankments and the filling in behind retaining Walls.*" By John B. Hartley, M. Inst. C. E.

The numerous failures of the embankments in the construction of railways, and the constant occurrence of defects in retaining walls, induced the author to offer some remarks upon the subject. He first examines the ordinary mode of commencing the embankment at the contemplated finished level, and proceeding with the work at that height throughout, leaving the material to find its own inclination; forming the required slopes on the sides when the filling is completed. This he contends (although without doubt the most rapid mode of proceeding) is defective in principle, for the material as it is deposited forms layers or strata at such an inclination as its nature permits, and always has a tendency to slide in the direction of the slope. In such cases, as the centre sinks, the sides slide away, and having nothing at the feet to resist such a tendency, they are carried out to a dangerous extent. This is particularly the case with clay embankments, for the material is generally brought from the cuttings in large lumps, which cannot be consolidated as they are deposited; the water lodges in the interstices, keeping the bottom soft, and when it begins to subside it slides away, until it has formed itself into a slope at which it can resist the pressure. To prevent this sliding, the author recommends proper footings being prepared for the sides of the embankments by cutting trenches, about 4 feet 6 inches deep, along the bottom line of each slope, and forming a "cop" of sods or of stones, placed at right angles to the line of the slopes. These footings must be of a strength proportioned to the height of the embankment, and the whole length should be completed before the filling is commenced, that they may become solid, and the sods have grown together, before the weight is brought upon them.

Proposed mode of filling.—He advises, also, that instead of carrying ou the filling in one lift, two embankments should be made, varying in height from 15 feet to 20 feet, according to the nature of the material, wide enough for two earth wagons on the top, one of them running along each side of the site of the contemplated embankment; a valley would thus be left in the centre at the junction of the two inner slopes. When they have been carried along the whole length, or to such a distance as would insure their being considerably in advance, the second or the final lift may follow. With clay or soft materials, four low lifts following each other would be advisable; with these precautions slips of the embankments would be of rare occurrence. The bottom would become solid by the passing of the weight over it, and the succeeding lift being thrown into the centre valley, must settle vertically. The subsidence, which is always in the line of inclination, would be concentrated and thrown inwards; by these means the width of the slopes would be restricted, and the work would be constructed much cheaper, there being a saving of both land and labour. Land springs, which are usually only discovered by the pressure of the weight above, would be more easily reached with the low lifts than when covered by the heavy ones.

This mode of construction has been practised by Mr. Jesse Hartley, on the Manchester and Bolton Railway, where the embankments were very heavy, and the material of the worst description; yet the work was executed in a most satisfactory manner, and the cost of the maintenance of way upon that line is quoted as being less in proportion than on any other railway in the kingdom. This method may require more time, and be a little more expensive, but the author is of opinion that the trifling difference in time and cost would be amply repaid by the freedom from expense when the road was opened.

Retaining Walls.—The author then examines the subject of retaining walls. He considers the method of filling towards the wall from the natural bank behind to be highly objectionable; the material lies in strata at the angle at which the deposit is made; as the quantity increases, the subsidence commences, and the earth slides downwards, throwing its whole weight against the back of the wall. The tendency to slide is frequently accelerated by the natural form of the ground upon which the earth is thrown, as it not unfrequently inclines towards the wall, in which case the pressure will necessarily be in proportion to the inclination of the slope, and the nature of the material of which the filling is composed. The wall at Hunt's Bank, on the river Irwell, is instanced as a failure of this description. The wall, about 100 feet in length, and 20 feet in height, 5 feet thick at the bottom and 3 feet 6 inches at the top, built of ashlar masonry strengthened by counterforts, was forced into the stream by the pressure of the earth behind it. With proper attention to the manner of filling the different materials, a comparatively slight wall may be constructed to sustain a considerable weight of backing. The author lays down as a rule that, wherever it is practicable, all filling behind walls should be commenced at the wall, and be proceeded with from thence towards the solid ground, by which means the strata would be inclined in a similar direction; ledges or benches, either level or inclined in an opposite direction to that of the bank, should be cut in the solid ground to receive the filling, and counteract its tendency to slide. The weight should not be laid too quickly upon a new wall, and if with these precautions care be taken that the counterforts are constructed simultaneously with, and well tied into, the wall, a comparatively weak structure will bear a heavy mass of filling.

The author gives as an example the retaining wall constructed on the west side of Jackson's dam, near the Brunswick Graving Docks, Liverpool. This wall, although built of slight dimensions, and filled behind with material of the worst description, resisted perfectly all strain; this could only be attributed to the filling having been gradually done in the manner which the author's practice leads him so strongly to recommend.

This communication was accompanied by diagrams descriptive of the mode of constructing embankments.

May 25.—Henry Robinson Palmer, V.P., in the Chair.

"*A Tabular Statement of the Dimensions and Proportions of Forty Iron Vessels.*" By Lieut. E. N. Kendall, R. N., Assoc. Inst. C. E.

The vessels, the dimensions and proportions of which are given in this communication, were all built by Mr. John Laird of Liverpool; they are adapted to a variety of purposes, so that they present but little uniformity. The "Rainbow" and the "Glowworm" are celebrated for their speed; their proportions of beam to length are above one to six, and more than three tons to each horse power, which is generally assumed to be the proper ratio for sea-going steamers. The tabular statement gives the dimensions and tonnage of the vessels, the power of the engines, the proportion of beam to length, and of tons to each horse power, the names of the owners, and the stations where the vessels are plying.

"On the Stationary Engines at the [illegible] Tunnel on the Liverpool and Manchester Railway." By John Grantham, Assoc. Inst. C. E.

This communication gives a description of two pair of stationary non-condensing engines, which were constructed by Messrs. Mather, Dixon, and Co., of Liverpool, from the designs and under the superintendence of the author. The steam cylinders are 25 inches diameter, with a length of stroke of 6 feet; they have side levers like marine engines, but the connecting rods are reversed, and convey the power downwards to the machinery, which is placed in vaults cut out of the sandstone rock, upon which the beam pedestals are fixed without any framing. Cast iron slides are used instead of the usual parallel motion, and after several years' constant use, they exhibit no marks of deterioration. The drum wheel is 21 feet diameter, and makes usually 22 revolutions per minute, when drawing up a train at the rate of 15 miles per hour; there is a groove in its periphery, at the bottom of which is wound a small cord to form a bed for the main rope to rest upon—this main rope encircles about $\frac{3}{4}$ of the circumference; it is made of the best Russia hemp, in three strands, patent shroud laid, the inner strand being composed of 40 yarns of white hemp, overlaid by 40 yarns of hemp, tarred to the point of saturation; this arrangement is found most conducive to the lightness and durability of the rope; its circumference was 6 inches, and its length, when new, was 4800 yards; in the first few weeks it stretched to the extent of 10 per cent. of its length, after which it remained unchanged under the tension imposed. The total weight is 8 tons 8 cwt., and the cost was 2*l.* 8*s.* per per cwt. It is guided by 474 grooved pulleys, 14 inches diameter, and by 6 sheaves 5 feet diameter. A new rope will last well for three years, after which it is renewed by splicing in a short portion each time, so as to reduce the amount of stretching.

Inclined plane.—The length of the inclined plane is 2370 yards, at varying gradients; giving an aggregate rise of 77 feet 1 inch, and a mean rise of 1 in 92. The tunnel is 2220 yards long. The average weight of the trains drawn up is 55 tons, and the time occupied is six minutes. The pressure of steam is usually from 50lb. to 60lb. when the engines begin to wind, and sinks gradually to about 30lb. in the reservoir during the time it is working.

Power required to draw Carriages up the Inclined Plane.—From some experiments made by Mr. Edward Woods, the details of which are given, it has been ascertained that each pound per square inch pressure of steam upon the pistons over and above the 7·56lb. necessary to overcome the friction of the machinery, is capable of drawing one carriage weighing 5 tons gross up the inclined plane. On the first erection of these engines, in order to comply with the provisions of an act of parliament, it was necessary to work them with steam generated in boilers, at a distance of 448 yards, and conveyed through pipes 10 inches diameter, laid in a tunnel excavated through the rock. Several experiments were made to determine the relative amounts of pressure in the boiler and the steam reservoir, and the quantity of steam which was condensed in a certain time. The results were, that when the engine was standing still, the difference of pressure was about 3lb., and when working with a load it was as much as 13lb. The quantity of steam condensed was on an average about 156 gallons per hour. Subsequently, a set of tubular boilers, similar to those of locomotive engines, were erected close to the engines, and are now constantly worked instead of those at the great distance; the economy of fuel has been considerable. The consumption of gas coke under the tubular boilers is about 15 tons per week, at ten shillings per ton. The larger boilers consumed about 30 tons in the same time.

Mr. Edward Woods gives his approval of the action of the engines, and of the employment of non-condensing engines generally for this class of work, on account of their great simplicity, and the readiness with which they may be brought into full action, so that the greatest power is always at hand to start the train; whilst during the intervals of working the steam may be suffered to accumulate. These advantages are rarely attainable with condensing engines, as unless a small engine be employed to keep up the vacuum, there is a difficulty in starting them with the train attached to the rope.

This communication is accompanied by four detailed drawings of the engines and machinery, and by a model of Mr. Grantham's apparatus for regulating the admission of steam to the valves.

Observations.—Mr. Fairbairn bore testimony to the good quality of the engines and machinery described by Mr. Grantham; their performance had been very satisfactory. The mode of keeping the rope in tension was an improvement upon the plan which Mr. Fairbairn had previously adopted at the Wapping Tunnel, of the same railway. He would present drawings of that machinery to the institution. The loss by condensation in long steam pipes is so considerable, that it has been generally found more economical to transmit power by a line of shafts, than to convey steam to any great distance. He had recently constructed some Cornish pumping engines of large size, with side levers and reversed connecting rods; they had answered extremely well. Drawings and descriptions of them would be presented to the Institution.

"On the percussive action of Steam and other Aëriform Fluids." By Josiah Parkes, M. Inst. C. E.

In a previous communication "On the action of Steam in Cornish single-pumping Engines,"* Mr. Parkes, after a careful analysis of the ascertained facts of the quantity of water which, in the shape of steam, passed through the cylinders of the engines, arrived at the conclusion that the steam's elastic force was insufficient to overcome the resistance opposed to it. On obtaining this remarkable result, he was induced to examine the circumstances under which the steam is applied, and was convinced that from the instantaneous and free communication made between the boiler and the cylinder of these engines, an action, distinct in character from the simple pressure of the steam, must be transmitted to the piston. And, in order to convey some precise idea of the peculiar nature of this action, he adopted the term "percussion" to distinguish such action from that due to the simple elastic force of the steam. Various phenomena, connected with the working of the engine, were adduced in confirmation of the views then advanced. In the present communication Mr. Parkes has resumed the subject, and brought forward numerous facts derived from experiment and observation, on steam and elastic fluids generally, in farther corroboration of his opinions respecting the percussive action of steam in engines.

The effect of the percussive action of steam may be clearly traced on the indicator diagrams (a series of which, 41 in number, taken from four engines, with different indicators, the pressure of the steam varying from 6·5 to 34.7lb. per square inch, accompanied the communication), and it will be seen that, in every instance, the piston was driven to a greater height than that due to the simple elastic force of the steam: in many instances a greater pressure was marked than existed in the boiler. The difference in the action, according as the steam is admitted suddenly, or gradually, into the cylinder of the engine, may be also distinctly traced on the diagrams. The same effects were observed on the sudden admission of steam upon the surface of mercury in the cistern of a mercurial column. In these experiments, the steam being let on gradually, the gauge marked a pressure of 40lb. per square inch, which was the true pressure in the boiler; but, being admitted suddenly, the gauge exhibited a pressure of at least 60lb., and the same results were repeatedly obtained.

The steam generator of Mr. Perkins will afford a good illustration of the effect of the steam's instantaneous action. The pressure in this apparatus is denoted by an instrument having an index moving round a dial plate. Steam of 26 atmospheres being suddenly admitted, the index was observed, during repeated trials, to register a pressure as high as 36 atmospheres, and then to recede until it remained stationary at 26 atmospheres, which was the pressure in the generator. The results of these various experiments are arranged in two tables, exhibiting an analysis of the elements into which they may be resolved.

The author then proceeds to point out the different circumstances of the pumping and crank engines, in respect of their realizing, beneficially, the steam's percussive action. In the latter, this instantaneous action takes place (as the indicator diagrams show) when the connecting rod and crank are in one vertical line, so that it is inefficiently expended; the centre, by the agency of the fly wheel, not having been passed. In the former, the load and frictional resistance alone oppose the descent of the piston; the piston is free to move, and the steam's action is wholly efficient in impelling it; and, whatever the amount of the percussive action, it will be accounted for in the effect.

A remarkable confirmation of the conclusions arrived at, and the views advanced by Mr. Parkes in his previous communication, had been furnished by Mr. W. West. The cylinder cover of the Fowey Consols engine, 80 inches in diameter, and weighing 4 tons, springs upwards at the centre ·156 of an inch, on the sudden admission of steam, which in the boiler has a pressure of 49·7lb.; and $\frac{1}{4}$ of an inch, the steam in the boiler being 61·7lb.: but no change of form, or springing, occurs when the steam is let on gradually, and fills the cylinder at the same pressure as that in the boiler.

The author adduces many other facts in illustration and confirmation of his views; as, the oscillation of the mercury in steam and vacuum gauges; the audible sounds produced in a steam pipe on suddenly checking the motion of the elastic fluid by shutting a cock; the curious phenomena connected with the impact of elastic fluids on each other, particularly those observed by Mr. Greener on firing gun-powder in long open-ended barrels; and, in conclusion, suggests whether these remarkable facts may not serve to assist in elucidating some of the very difficult and apparently inexplicable phenomena, connected with the explosion of steam boilers.

Remarks.—Mr. Lowe had recently made some experiments, which in his opinion confirmed Mr. Parkes's views on this interesting subject. A pressure gauge, attached to a line of gas pipes, showed, when the communication was slowly opened, a pressure of four inches column of water; but it invariably exhibited a maximum of oscillation of full six inches column on the sudden opening of the small stop-cock between the pipe and the gauge. In a line of pipes, full of gas, the whole volume of gas received an impulse on suddenly opening the valve at one end, and the passage of the undulating wave was indicated by the sudden and successive depression of the water in the gauges along the whole line.

Mr. Homersham could not agree with Mr. Parkes as to the effect due to

* See Transactions Institution C. E., Vol. III.

what he termed the "percussive action of steam;" he believed that the superior economy of the Cornish engines, as far as related to the action of steam in the cylinders, would be found to be due to the amount of the expansion of the steam; which depended, not only upon the opening and closing of the steam valve, but also upon the greater or less area of the aperture of the throttle valve. It was evident, that on closing the steam valve, the space between it and the throttle valve would be filled with steam of a density nearly, or quite, equal to that in the boiler; therefore, on the first admission of the steam into the cylinder, it might be presumed to act upon the piston with that pressure; considering, likewise, that a short interval of time necessarily occurs for setting in motion the beam, with the heavy pump rods appended to it; but immediately the piston starts, expansion takes place, as the throttle valve prevents the steam from following the piston freely, so that a greater degree of expansion must take place when the steam is at a higher density; for the throttle valve being then more closed, offers a greater resistance to the steam following the piston. The indicator diagram of the East Crinnis Engine showed this effect to a certain extent, although neither in that nor in the diagram of the Huel Towan Engine was there nearly the same degree of pressure exhibited in the cylinder at the commencement of the stroke, as in the boiler; but it was evident that those diagrams could not be relied upon, as they did not account for the whole duty done by the engines, either on the percussive or the expansive principle. Assuming a bushel of coal to weigh 94lb. as generally reckoned in Cornwall, and that 1lb. of coal would evaporate $10\frac{1}{2}$lb. of water, it could readily be shown, that the quantity of water converted into steam by one bushel of coal, would, when expanded in a cylinder, during $\frac{19}{20}$ of the stroke, lift upwards of 257 million lb. one foot high in one minute; which was a much greater duty than was realized by any Cornish engine.

Mr. Seaward allowed that Mr. Parkes had clearly shown, that a certain amount of effect was due to the sudden impact of the steam upon the piston of a pumping engine. Whether the term "percussion," as applied to this action, was the proper one, he would not then examine; but the effects shown to have been produced, and the phenomena attendant upon the exhibition, were so remarkable, that he conceived the subject to merit the most deliberate investigation of engineers as well as philosophers. He had previously objected to the theory, on the ground that the effect could only be in the ratio of the weight of the steam multiplied into its velocity; but he believed the subject must be examined in a different manner; and although the principle must always have existed, it was only in consequence of modifications in the application of steam, that the effects had been so fully developed.

Mr. Parkes mentioned, that since his paper had been written, he had found an experiment which was strictly analogous to his proposition. It was related by Mr. Robins, who was so justly celebrated as a mathematician and philosopher, and first discovered that the gas evolved from gunpowder was a permanently elastic fluid: "when gunpowder is fired in an exhausted receiver, the mercurial gauge instantly descends upon the explosion, and as suddenly ascends again. After a few vibrations, none of which, except the first, are of any great extent, it fixes at a point which indicates the density of the inclosed gas." He considered this result as corroborating those obtained by himself, as well as justifying the comparison he had drawn between the instantaneous action of gunpowder gas and steam. Mr. Robins's words precisely described the steam's action, as traced on the indicator diagram exhibited. The springing of the cylinder cover referred to, and in the manner stated, must, be thought, satisfy every one, that the steam's instantaneous action far exceeded in effect that of its simple elastic force, which was proved to have been unequal to produce any change in the parallelism of the cover. As regarded Mr. Homersham's investigation of the power of the steam in the Huel Towan engine, it was correct that the initial steam was in a state of expansion during $\frac{19}{20}$ of the stroke, but not all the steam, for it had not all entered the cylinder until the piston had travelled through nearly $\frac{5}{20}$ of the stroke. His calculations were, therefore, hypothetical, and not in accordance with the facts of Mr. Henwood's experiment.

THE CALEDONIAN CANAL.—THIRTY-SIXTH REPORT OF THE COMMISSIONERS.

Few undertakings have been more singularly and uniformly unfortunate than the one which forms the subject of the present report.

Though originating in the purest and most praiseworthy motives, though directed by the talents of a Telford, and supported and carried out by an almost unlimited supply of public money, this canal appears to have arrived at such a point of dilapidation and decay, and to be attended with such peculiar difficulties, that it has at length become equally impossible either to advance or recede, without incurring a further enormous outlay and expense.

In this situation, and as the lesser evil, it would appear that a select committee of the House of Commons, appointed in 1839, for the purpose of examining into the affairs of the canal, made a report, wherein they recommended that a further advance of public money to the amount of £200,000 should be made, for the purpose of completing and finishing it properly and effectually, so as to render it available for the purposes for which it was originally intended, giving it as their opinion, that inasmuch as a vast sum of money had already been expended on the concern, which, though at present unproductive in a pecuniary point of view, had still, to a certain extent, been beneficial to the country through which it passed; and as destroying the works, filling up the canal, or abandoning the undertaking altogether, must be attended with a further expense for the purpose of making the country secure from inundation, which expense would amount to as much as would put the canal in good working condition and repair, they felt that the choice left them was only one of two positive evils, either of which must be attended with an equal outlay, and that, therefore, it was not advisable to sink the money already expended and put up with the dead loss; but rather, by expending the same money in rendering the canal more easily navigable, and more adapted to the purposes of commerce, to take the chance which, though remote, might yet by possibility render the undertaking sufficiently productive to pay its own expenses, and thus leave it, if not a positive benefit to the present generation, in a commercial point of view, at least a gigantic monument to posterity of British industry, ingenuity, and talent.

In order to account for the enormous but fruitless outlay of the public money, which, in the present instance, has already exceeded £1,000,000 sterling, without including the £200,000 above-mentioned, it will be necessary to go back into the origin of this undertaking, and to trace the causes which have led to this unsuccessful result.

It would appear that, in the year 1803, France having, by successive aggressions, arrayed the whole of Europe, and more especially the great northern Powers, against her great maritime rival, and there being no naval station of any consequence in the north of England, the whole coast of Scotland or the north-west of Ireland, the enemy had it in his power to annoy this part of the country from the North Sea, by passing round the Orkney Islands, whereby the commerce of a considerable portion of the United Kingdom frequently suffered great and serious losses. This circumstance, and the idea of affording employment to the inhabitants of the highlands of Scotland, who at that time were in great distress, and were rapidly emigrating from home, were much pressed on the attention of the Government of that day, and caused the subject to be taken into serious consideration, and enlarged views were developed by describing the singular valley called the Great Glen of Scotland, which, commencing between the promontory of Burg Head in Elgin and Cromarty, passes through a succession of sea inlets and fresh water lakes to the southern extremity of Cantyre, for a distance of 200 miles, and in nearly a straight direction between the Naze of Norway and the north of Ireland, and which, it was alleged, afforded great facilities for internal navigation. It was said that the whole of this extensive valley, with the exception of 22 miles, being occupied by navigable waters, and the excepted space by a navigable canal, would save upwards of 500 miles of dangerous navigation.

With these views the Caledonian Canal was originally undertaken; but though there can be no doubt that the natural features of the country suggested the plan, yet it is doubtful whether it would ever have been entertained but for the distressed state of the Highland population, which it was an object to relieve, by affording them employment, and this being best attained by extensive public works, was the immediate cause which led to the adoption of the scheme.

Accordingly Telford was employed to examine the line of country indicated, and having testified to its practicability he was alone employed to carry the design into execution, agreeably to a plan he had furnished.

By this plan it was proposed to form a canal large enough to admit of the navigation of a 32-gun frigate throughout its whole length, and the estimated cost of the work in question was fixed by him at an amount of £350,000. This estimate was subsequently increased to £474,500, but which latter sum fell very far short of the real expense incurred in the undertaking. This singular difference between the estimate and the real cost was said to arise from the fact, that subsequently to the estimate being given in, a serious rise had taken place, as well in the value of timber as in the cost of labour (consequent on the rise in the price of provisions), and something must also be attributed to the want of experience in estimating the cost of works of such a gigantic nature; from these causes, and from other unforeseen difficulties, the canal was not opened to the public until many years had elapsed from the time of its commencement.

In the meanwhile, and during the period wherein these works were going forward, the enormous inaccuracy of the estimates became every day more apparent, and much opposition was manifested in various quarters to any further advance of the public money towards carrying out the objects of the scheme; under these circumstances, and finding increased difficulty in raising the supplies necessary to complete the work, the commissioners determined to open the canal to the public in its unfinished state, and accordingly, in 1822, the canal, though only partly completed, was opened to the public, and in which state it has remained up to this time.

The consequence of this premature opening led to numerous accidents and misfortunes, and to frequent interruptions of the navigation.

Up to the time of opening the canal, the expences of its construction had amounted to the enormous sum of £905,258, which amount had in May, 1839, been increased to £1,023,628, exclusive of a debt to the Bank of Scotland of £39,146.

From the very first hour of its being opened to the public, the canal, in a pecuniary sense, has been a losing concern, never having paid even the expenses of keeping it in repair, much less leaving any surplus available to the liquidation of its debts. On the contrary, the commissioners have been compelled every year to make application to the Bank of Scotland for advances necessary to complete repairs imperatively called for; neither has the traffic upon the canal been such as to encourage the idea of its ever being, at least as at present constituted, a very successful undertaking.

In the mean time, the works of the undertaking seem to have been gradually deteriorated until the latter end of the year 1837, when a serious accident occurred to the lock at Fort Augustus, and this being followed by other extensive damage, information was forwarded of the state of things to the Lords of the Treasury, and their attention was drawn to the bad state of the canal generally, and to the danger to be apprehended to the large district of the neighbouring country from the defective condition of many portions of the works, more especially the Gairlochy lock.

Accordingly Mr. Walker, the engineer, was directed by the Treasury to proceed to the spot, and to ascertain the nature and extent of the damage sustained, with which directions he complied, and further gave instructions for doing what was then immediately necessary.

In the year following a committee of the House of Commons was constituted for the purpose of hearing evidence on the subject of the canal, and Mr. Walker and Mr. May, the resident engineer, attended and testified to the state of the works.

From this evidence, it appeared that much danger was to be apprehended to the works themselves, and also to the country adjacent, as well as to the lives and property of individual inhabitants resident in the neighbourhood of Gairlochy. It was stated that at this lock the waters of Loch Lochie, which extend over a surface of 6,000 acres, had been dammed many feet above their natural level, and that they were supported at that height by only one pair of gates, on the breaking of which the outpouring water on the adjoining country would occasion such a loss of life and property that no time ought to be lost in guarding against such an occurrence. It further appeared, that other parts of the works were in an exceedingly bad state, and were hourly becoming worse.

Upon being questioned as to the reason of the canal not being used by shipping, these gentlemen stated that the objection to the canal on the part of the masters and owners of craft arose from the uncertainty of water, and from the want of steam-tugs, as it would be impossible to form towing paths on the borders of the lake.

Upon being pressed to state what sum would be required to put the canal in a proper and efficient working state, inclusive of everything, he estimated the amount to be required for that purpose to be £200,000 more, and advised that course to be adopted in preference to abandoning the canal altogether, as he stated, that in the event of that course being adopted, the expence of fence works, &c., necessary to prevent the country from being overflowed, would be as great as the expense of repairing, and this without the possibility of a return, not to mention the claims of parties for compensation, &c.

After hearing other evidence to the same effect from other parties, the committee became of opinion that the proposition for abandoning the canal altogether was one that ought not to be entertained, and after making numerous inquiries with the object of ascertaining whether any increase of business would be likely to accrue if a certain passage through the canal could be obtained, and having ascertained that point, and that thus the dangerous and tedious navigation of Pentland Frith might be avoided, they resolved, that the navigation of the canal was insecure; that the state of the canal should be immediately attended to, not only as regarded the preservation of the work, but also as relating to the security of life and property in the districts through which the canal passed; that they could not recommend the abandonment or shutting up the canal, and that the insufficiency of water, the imperfect execution of the works, and the absence of steam tugs, had prevented the development of the benefits to commerce which might be expected; that much benefit would arise to the trade and commerce on the canal, if the works were placed in a sufficient state of repair, if the depth of water were increased, and the assistance of steam tugs were afforded, as recommended by Mr. Walker; and for these purposes they recommended that a further sum of £200,000 should be advanced by Government.

The following are some observations upon the Report by the *Times*:—

Subsequently to this report it appears that certain propositions had been made to carry the recommendations of the committee into effect by private enterprise, by which means the necessity of application to Parliament for more money would be obviated, and this great national work rendered more available to the interests of the country without the further expenditure of public money.

In consequence of this proposition the committee re-assembled and resolved that such arrangement would be desirable under certain conditions, which were, that the Treasury should grant a lease of the canal and its appurtenances to the adventurers for a term of 99 years, gratis; that the company, before the execution of this lease and the application to Parliament, in lieu of the 10 per cent. deposit, should pay £45,000, to be applied in liquidation of the debts now owing on account of the canal; that the works recommended by Walker should be executed, and should afterwards be kept in repair, and that the company should relieve the Treasury and the commissioners of the canal from all responsibility from accidents and damage, and should, at the expiry of the time, leave it in good repair.

In the event of these terms not being acceded to, the committee recommended the matter to be again left in the hands of the commissioners as before.

It would appear, by the report now under consideration, that Government were unable to effect a transfer of the Caledonian Canal upon the terms suggested by the select committee of the House of Commons, and, consequently, the navigation has remained under the charge of the commissioners during the past year.

Notwithstanding the severity of the winter of 1840-1, no further serious damage was sustained by the works, nor is any material deterioration of the general condition of the works apparent; still it cannot but be felt, especially with respect to the very important locks of Gairlochy and Fort Augustus, that the lapse of every additional year renders their situation more precarious.

Little further of any interest appears upon the face of this report beyond the unpleasant fact that the receipts to the 1st of May for dues received to that day amounted to £2,728 9*s*. 8*d*. exclusive of a further sum of £173 0*s*. 7*d*. for rents, whilst, on the other hand, the expenditure amounted to £6,120 1*s*. 6*d*. and the total debt to the Bank of Scotland up to the same time amounted £23,592 9*s*. 1*d*.

It further appears that during this time 1,283 vessels had made use of the canal, paying in respect of tonnage rates £2,728 9*s*. 8*d*.

Little else can be gleaned from this report than what has been hereinbefore stated, nor does it appear that anything has since been done towards carrying out the recommendations of the select committee of the House of Commons.

Upon the whole, a perusal of the report affords no ground for forming any judgment on the propriety or good policy of adopting the advice of the committee to repair the canal; yet it is difficult to imagine what other course could be adopted under the circumstances of the case, as it is evident that by abandoning the undertaking the commissioners would save nothing in the way of expense, and that the amount which would be required to make the ground safe after them would be sufficient to repair the canal, and to provide that description of steam power which seems all that is required to make the passage through the canal preferable to the round sea voyage, presuming the canal to be in that perfect state of repair as to obviate the chance of danger to those travelling on it. At any rate, if we can believe the evidence adduced before the House of Commons on the subject, there can be little doubt that the steps recommended would greatly increase the traffic, and would render it, presuming the canal to be in such a state of solid repair as to be lasting, capable of paying its own annual expenses, and, perhaps, lay by enough to provide for future unforeseen contingencies. We confess we are adverse to seeing the enormous sum of money already expended absolutely sunk and sacrificed without making some further effort to make the canal useful, and we should greatly regret to see the gigantic conception of Telford's mind sink into neglect and oblivion without an effort to save it from such a fate.

REVIEWS.

An Experimental Inquiry concerning the relative Power of, and Useful Effect produced by, the Cornish, and Boulton and Watt Pumping Engines, and Cylindrical and Wagon-head Boilers. By THOMAS WICKSTEED, M. Inst. C. E. and Engineer to the East London Water Works. London: John Weale, 1841.

THIS highly interesting paper, as many of our readers may be aware, was presented to the Institution of Civil Engineers during the last session, but as there was not sufficient time left to allow of its being read the same session, the author obtained permission of the Council to withdraw it, for the purpose of publication in the present form.

Its nature and object are clearly and concisely defined in the first and last paragraphs of the preface, which we here subjoin.

"Those who take up the following paper in the expectation of meeting with a theory of the Cornish Engine will be disappointed, as it is little more than a plain narrative of the result of experiments made with a view to establish the *commercial* value of two classes of Pumping Engines."

"With respect to the calculations introduced into this paper, it is to be observed that the mode in which they have been worked is given, as well as the results recorded. If, therefore, the calculations are objected to, an opportunity is afforded of adopting a different method. The facts will remain the same, and it is hoped they cannot fail to be useful."

The work is divided into two parts; the first relating to the boilers and fuel, the second to the engines.

In the first part, the author describes the mode in which the experiments upon cylindrical and wagon-head boilers were made, which cannot fail to inspire confidence in the accuracy of the *facts* observed, although we think the deductions therefrom will bear some little modification. It is, however, satisfactorily shown that not the slightest reliance can be placed in an experiment of short duration to ascertain the duty of an engine. The author gives a statement of "the duty done each 12 hours (excepting in one instance, that of the highest duty, which was for six hours only,) by the engine, coals from the same heap being used." The experiment lasted 185 hours. In these 16 observations the highest duty was 118,522,475 lb. lifted one foot high with 91 lb. of coals, the lowest 63,650,298 lb., and the average 86,180,018 lb. From which it appears that the *highest* duty was 37 per cent. above the mean, and the *lowest* 26 per cent. below the mean.

"Finding the disparity so very great in these experiments," the author "commenced a fresh series, with a view of ascertaining the actual evaporation of water with cylindrical and wagon-head boilers under different circumstances of surface exposed to the action of heat, of coals burnt per square foot of grate, of quantity of water evaporated, and, as regards the wagon-head boiler, *with* and *without* clothing: wishing also to ascertain the comparative merits of the two engines, he recorded the average quantity of water used per stroke in the form of steam."

The following statements are calculated to give weight to the results recorded by Mr. Wicksteed in the work before us.

"The time occupied in the trials upon the cylindrical boilers was above 3400 hours, the coals consumed above 900,000 lb., and the water evaporated nearly $7\frac{3}{4}$ millions of lb. Upon the wagon-head boiler the time occupied was 1291 hours, the coals consumed nearly 600,000 lb., and the water evaporated above $1\frac{1}{2}$ millions of lb."

The quantity of water supplied to the boilers was accurately determined by means of a cistern "gauged by *weighing* 21 cwt. of water into it, and marking the height of each cwt. upon a floating gauge-rod;" which is of course the same thing as if it had all been weighed.

"The coals were actually *weighed, not measured*, into the stoke-hole, and the surplus, if any, was also weighed at the end of every 12 hours."

The results of these experiments on boilers are contained in Table No. V., in which are also given all the details of the experiments; and, from a comparison of columns 16 and 22, which show *the weight of fuel burned per square foot of grate per hour*, and *the weight of water evaporated by one lb. of coals from 80°*, respectively, we should conclude the latter to be independent of the former, since there is not the slightest correspondence to be perceived in the variations of the two quantities, if these variations be observed throughout the whole series of experiments; but the author, by comparing only the six experiments upon all four Cornish boilers, and the one upon the wagon-head boiler, when most perfectly clothed, found the evaporative effect of a pound of coals to increase with the rate of combustion per square foot of grate. He gives the following table of the mean results of the six experiments upon the Cornish boilers, three with quick, and three with slow combustion.

	Quick.	Slow.
Pound of coals per hour - - -	342·	188.
Cubic feet of water per hour - -	46·9	25·4
Pounds of coals per square foot of grate per hour	4·682	2·596
Pounds of water evaporated per lb. of coal from 80°	8·524	8·426
Ratio - - - - -	100	98·8

In this comparison the advantage of increasing the rate of combustion from 2·596 lb. to 4·682 lb. per square foot per hour, or a little more than 80 per cent. appears to be nearly $1\frac{1}{6}$ per cent. But if this advantage can with certainty be attributed to the more rapid combustion, ought we not to expect the same advantage to accrue from a still greater increase in the rate of combustion, with two or three of the same boilers?—This does not, however, appear to have been the case. The mean rate of combustion in the 26 experiments upon 2, 3 and 4 cylindrical boilers was 5,013 lb. per square foot of grate per hour, and the mean evaporation per lb. of coals, 8·224 lb. of water from 80°. The slowest rate of combustion was 2·475, with the 4 boilers, and the corresponding evaporation, 8·258 lb., or 0·41 per cent. above the mean; and the quickest rate of combustion, with two of the same boilers, was 8·708 lb. with an evaporation of only 8·082 lb. of water per lb. of coals, which is 1·73 per cent. below the mean. The mean of the six highest rates of combustion with the cylindrical boilers was 7·717 lb., and the corresponding mean evaporative effect of a pound of coals, 8·038 lb., or 2·26 per cent. below the mean of all the 26 experiments upon Cornish boilers. The rate of combustion under the wagon-head boiler (when well clothed, as the comparison would not otherwise be fair) was 10·89 lb. per square foot of grate per hour, and the evaporative effect of a pound of coals in that boiler under those circumstances, 8·301 lb.; but the engine was only worked during the day time, whence resulted a loss of effect equal to 1·78 per cent., so that the evaporation per pound of coals, if the boiler had been worked continuously night and day, as the cylindrical boilers were, would have amounted to 8·449 lb., or 2·74 per cent. more than the mean of the cylindrical boilers, the rate of combustion being rather more than double. If, however, Mr. Wicksteed had happened to make only one experiment with the cylindrical boilers (as he did with the wagon-head boiler well clothed), and that one had been the 2nd in the table, in which the rate of combustion was equal to the mean of the 26 experiments, but the evaporation 8·605 lb. per pound of coals, the advantage would have appeared in favour of the cylindrical boilers with slow combustion. It would seem, therefore, from these results, either that the proportions of grate and heated surface to the quantity of coals burned per hour exercise little or no influence on the evaporative economy of a boiler, or that experience is not yet sufficient to justify any conclusions on that head. However this may be, the facts here recorded are extremely valuable, inasmuch as they are the results of long continued and carefully conducted experiments, of which we are made acquainted with all the circumstances generally considered necessary to be known. They seem to indicate that each experiment, in order to be conclusive, ought to last as long, or nearly so, as all the experiments upon the cylindrical boilers taken together, and that all the circumstances connected with the management of the fires ought to be closely attended to, some of which are not observed at all, such as the supply of air to the furnace, and the temperature of the air in the chimney, if they can be ascertained, even comparatively; for it is very probable that these circumstances varied much in the experiments under consideration without its being perceived, and thus caused variations in the evaporative results, which may be ascribed to other causes. The experiments upon the wagon-head boiler appear, however, to prove very clearly the great advantage of efficient clothing, since the evaporative effect of a pound of coals increased invariably with the quantity of clothing, the advantage of a well clothed boiler over the same boiler entirely exposed being shown to be equal to 10·8 per cent. which produces so important a saving of fuel, that the practice of clothing boilers cannot be too strongly recommended.

We extract the following calculation made by Mr. Wicksteed to show which kind of boiler is preferable in a *commercial* point of view.

"One wagon-head boiler evaporated 54·5 cubic feet per hour, and weighed $7\frac{1}{4}$ tons. Four cylindrical boilers evaporated 46·9 cubic feet per hour (the most rapid evaporation), and weighed 48 tons. If 46·9 cubic feet required 48 tons of boiler, 54·5 cubic feet would require $55\frac{1}{2}$ tons.

	£	s.	d.
Cylindrical boilers, $55\frac{1}{2}$ tons at £27 -	1498	10	0
Wagon-head boilers, $7\frac{1}{4}$ tons at £27 -	195	15	0
Difference - -	1302	15	0

"Supposing the boilers are worked 365 days, the whole 24 hours, the coals consumed by the cylindrical will be equal to 1556 tons per annum, and by the wagon-head boiler 1569 tons, the saving in favour of the cylindrical boilers is equal to 13 tons of coals, which at 20*s.* is equal to 13*l.* It would be useless to continue the comparison of the *commercial* merits of the two classes of boilers farther."

From the results of his experiments on the evaporative power of various coals, the author has formed the following table,

"SHOWING THE COMMERCIAL VALUE OF THE COALS.

The price of small Newcastle coals evaporating 7·68 lb. of water per lb. of coals was, in 1840, 14*s.* 6*d.* per ton in the Pool; this price is taken as a standard, and the value given is according to the evaporative power of the different varieties.

	Water evaporated per lb of coals.	Value per ton in the Pool.	
The best Welsh - - - -	9·493	17*s.*	11*d.*
Anthracite - - - - -	9·014	17	0
The best small Newcastle - -	8·524	16	1
Average small Newcastle - -	8·074	15	$2\frac{3}{4}$
Average Welsh - - -	8·045	15	$2\frac{1}{4}$
Coke from Gas-works - -	7·908	14	11
Coke and Newcastle small $\frac{1}{2}$ and $\frac{1}{2}$ -	7·897	14	$10\frac{3}{4}$
Welsh and Newcastle, mixed $\frac{1}{2}$ and $\frac{1}{2}$ -	7.865	14	10
Derbyshire and small Newcastle, $\frac{1}{2}$ and $\frac{1}{2}$	7·710	14	$6\frac{1}{2}$
Average large Newcastle - -	7·658	14	$5\frac{1}{2}$
Derbyshire - - - -	6·772	22	$9\frac{1}{2}$
Blythe Main, Northumberland -	6·600	12	$5\frac{1}{2}$."

We have seen that Mr. Wicksteed's experiments upon Cornish and wagon-head boilers do not establish any certain superiority of either over the other in evaporative economy, although Mr. Parkes, in his paper *on Steam Boilers and Steam Engines*, published in the 3rd volume of the *Transactions of the Institution of Civil Engineers*, states the Cornish to be superior to the common wagon boiler by as much as one-third. It is, however, to be remembered that this conclusion is drawn from experiments of short duration compared to those made by

Mr. Wicksteed, and consequently not to be depended upon; nevertheless we cannot but think that a still longer continuance of observations is necessary to confirm the opinion expressed by Mr. Wicksteed, that evaporative economy is promoted by more rapid combustion, as compared to the slow combustion effected in the Cornish boilers, the rapidity of combustion being measured by the weight of coals burned on each square foot of grate per hour, for we do not consider it fully borne out even by his own experiments. Nor should we have supposed that the amount of heated surface which would produce the maximum of evaporation with a given weight of fuel had been surpassed, even in the Cornish boilers, which Mr. Wicksteed states to be proved by his experiments.

With the *engines* the case is very different:—the circumstances which affect the economy of *steam* are simple and manifest, and their effects easily ascertained and measured: for which reason this part of the investigation is much more satisfactory than the former. But the *duty* or effect produced by the engine with the consumption of a given quantity of fuel, resulting from the combination of the evaporative economy of the boiler, and the economy of the engine in the expenditure of steam, must necessarily be an uncertain criterion of the excellence of an engine, unless deduced from observations continued through a considerable length of time, and unless due account be taken at the same time of the various circumstances affecting the evaporative economy of the boilers. For this reason the author has adopted the judicious plan of separating the two sets of causes and effects, by ascertaining, for the boilers, the weight of water evaporated per lb. of coals, and for the engines, the weight of water used as steam in the engine to produce the observed effect. By this means he has been enabled to obtain the relative commercial values, if not of the boilers, at least of the engines experimented upon.

By an inspection of Table No. VII., which contains the particulars of the experiments upon the engines, it will be seen that the duty increases progressively with the degree of expansion of the steam in the cylinder; also that there is very little difference between the mean steam pressure on the piston and the mean resistance, that difference being in favour of the steam pressure, thus proving that there is no necessity whatever to call in the *percussive force* of the steam to assist its elastic force in overcoming the resistance, according to the new theory which Mr. Parkes attempted to establish.

It will be remarked, on examining column 27 of this table, that the mean steam pressure was always found to exceed the mean resistance, and that the excess increased progressively with the degree of expansion: but on this point we have one or two observations to make.

The mean steam pressure, (column 21), is calculated from the quantity of water in the form of steam used per stroke in the cylinder, (column 9); the quantity of steam remaining in the cylinder from the preceding stroke when the steam valve is opened (column 12), deduced from the pressure of that steam (column 9); the space above the piston upon the shutting of the steam valve (column 15), whence is deduced the pressure of the steam before expansion (column 16); the proportion of the stroke through which the steam expands, (column 20); and the pressure at the end of the stroke (column 17).

We have to observe with respect to these calculations, that the pressure of the steam is always supposed to be proportional to its density, (except in the case of col. 13, where Tredgold's rule is used to determine the volume of the steam at boiler pressure generated from the quantity of water used per stroke) which occasions a slight error in each of the columns 12, 14, and 16; and in col. 17, an average pressure at the end of the in-door stroke of 6·7lb. per square inch is assumed, but which we find by calculation from the quantity of water used per stroke, supposing the pressure in column 11 to be correct, to vary in the five experiments upon the Cornish engine from 8·02lb. to 6·09, diminishing as the degree of expansion increased. After making these corrections, as well as a slight alteration in col. 13, from the use of a different method, we find the mean pressure of steam in the experiments B, C, D, E, and F, = 12·58lb., 12·39lb., 13·06lb., 13·33lb., and 12·8lb., respectively, the mean resistance in all cases being assumed to be 12·94lb., the power thus appearing to be sometimes superior, and sometimes inferior to the resistance, but never differing from it more than 0·39lb., per square inch, which may almost be considered as a practical equality.

In the experiment H, on the Boulton and Watt engine, the excess of the steam pressure over the resistance becomes greater after the corrections; but that is evidently to be accounted for by the quantity of water used per stroke being estimated too highly, for we find the pressure at the end of the stroke 12·83lb., (instead of 10·25lb., as given in the table both for this pressure and that of the steam remaining in the cylinder before the steam valve is opened), which is no doubt erroneous. At all events these experiments sufficiently prove the capability of the Cornish engine to perform the duty it is asserted to do.

We regret that we cannot give a few more extracts from this valuable work, which contains several tables that deserve the attentive perusal of all parties in any way connected with the steam engine, particularly in a *commercial* point of view. To Mr. Wicksteed the public are greatly indebted for his indefatigable exertions and perseverance in carrying out his experiments, and laying the facts open to all without the slightest concealment or mystery.

Lardner's Cabinet Cyclopædia—Treatise on Electricity, Magnetism, &c. By Dionysius Lardner, LL.D. Vol. I. London: Longman & Co. 1841.

The Cabinet Cyclopædia has now reached its 130th volume, a sufficient proof of its popularity and its consequent utility. In the present work Dr. Lardner discusses electricity, magnetism, electro-chemistry, electro-magnetism, terrestial magnetism, &c., subjects all of the highest interest, and of the greatest importance to the votaries of science and to practical men. The progress of these sciences is most rapid, every day new powers are developed, and new and extraordinary applications are carried into effect. The mere experimental history of electricity is important as shadowing out the future, were not the results already produced sufficient to stamp its value. Under such circumstances the necessity for a popular digest of the scattered information on electricity is imperative, and also that it should be executed by one who has proved himself competent for the task. In the next volume Dr. Lardner proposes to conclude the treatise, to record the latest discoveries, and describe the several practical applications. We are glad to see the severity with which the Doctor handles M. Arago for trying to supplant Franklin by a French intruder, as he subsequently attempted to do with regard to Watt, when he received merited castigation at our hands.

View of the Ouse Valley Viaduct on the London and Brighton Railway. London: Ackerman & Co. 1841.

The great progress of those magnificent public works, the railways, has led to the publication of numerous engravings devoted to their illustration. Messrs. Ackerman, who are so successful in the pretty, seem determined to show their capability for the grand, and they could scarcely have chosen a better subject than Mr. Rastrick's Ouse Valley Viaduct, which steps across the Lowlands with 37 arches of 30 feet span, the highest standing a hundred feet above the water.

Elements of Perspective Drawing. By Augustus Deacon. London: Taylor and Walton. 1841.

This work, the designs only of which are by Mr. Deacon, but the plan of which emanates from a well-known promoter of this branch of education, is calculated to be highly useful to the student of mechanical drawing. The author grounds his system on the use of a series of models, to which, however we should object in some cases, as being too small; some system, however, is better than the present want of system.

A Letter to the Shareholders of the Bristol and Exeter Railway. By W. Gravatt, C.E., F.R.S. London: M'Dowall. 1841.

We really do not see that we can with propriety enter into the subject matter of this pamphlet, for there has been already so much unpleasant discussion and recrimination, that we are most unwilling to have our columns occupied with a subject so painful, which the farther it is debated, the more productive of ill-feeling does it become.

Outline of a system of Model Mapping. By J. Bailey Denton, Surveyor, Gray's Inn Square. London, Weale, 1841.

Mr. Denton's chief object in producing this pamphlet, has been to call the attention of the agricultural interests to the superiority of model mapping as a means of delineation, and to its application as a basis for draining and irrigating operations. The author shows forcibly the advantages to be derived not only from a proper collection of the waters on an estate, but from their proper distribution and application to useful purposes. He also proposes that model mapping should be resorted to in all designs for the draining of towns. Some of Mr. Denton's specimens we have seen, and they appear to possess a minuteness and accuracy of detail, which is calculated to give satisfaction to those who may avail themselves of this useful art.

THE CALCULATING MACHINE.

There are few efforts of the mind more fatiguing, more irksome, dry and monotonous, than the drudgery of making long calculations. The fixed and unceasing attention to a subject in itself devoid of interest, when the slightest intrusion of thought or fancy destroys the work already done, and compels us to return our weary way, is enough to addle and stupify the brain. No wonder, then, that, from times immemorial, the ingenuity of man should have been directed to the discovery of some contrivance, whereby this wearisome labour might be lightened or abridged. Hence the invention of calculating instruments and mechanical aids of various kinds. This long-sought desideratum appears at length to have been obtained; but before we present to our readers some account of the latest attempts of this kind, we will take a rapid glance at the various endeavours previously made to accomplish the end in view, and which will place in a more conspicuous light the merits of this new invention.

The instruments hitherto contrived for assisting or abbreviating calculations may be classified as follow:—

1. Such as supersede the mere setting down of figures, but requires as close an application of the mind as common arithmetic. To this class belong the calculating boxes of the Russians and Chinese, where the figures are represented by balls moved by wires. Even the Romans possessed an instrument of this kind, called Abacus, in which the figures were indicated by buttons running in grooves.

2. To another class belong such instruments as are constructed on the following principle, viz.:—Two long slender rules are divided into 100 equal parts, those parts being numbered from 0 to 100, and are thus used: If, for instance, it be desired to add 17 to 23, the rules must be so placed that the 0 of one shall be exactly opposite to 17 in the other, then by finding 23 on the first, you will have below it on the second the number 40 as the result. If, on the contrary, you wish to subtract one number from another, as 13 from 30, the number 13 on one rule must be brought opposite to 30 on the other, and under the 0 of the former you will find 17, the remainder. Such contrivances, being of very limited utility, and partaking more of the character of toys than of practical inventions, have long since sunk into oblivion. Instruments on this principle, some square, and others of a circular form, have been produced by Perrault, in 1720; Poetins, in 1728; Peregre, in 1750; Prahl, in 1789; Gruson, in 1790; Guble, in 1799, &c.

3. A third class of instruments for assisting calculators, comprises the "Virgulæ Neperianæ," as likewise the other two works of this celebrated Scotchman—namely, his *Multiplicationis Promptuarium*, and his *Abacus Arcalis* in 1617. In his footsteps followed Caspar Scott, 16_0; Demeam, 1731; Lordan, in 1798; Leopold, Pelit, and others.

Equally well known with the foregoing is the calculating scale, so much used by the English in mechanics, which was invented by Michael Scheffelt, of Ulm, in 1699.

All the contrivances above enumerated, and others which we pass over in this brief sketch, do certainly diminish the labour of arithmetical calculations, more or less, but they all require the attention to be fixed, and do not completely attain the object sought. Hence the aim of scientific men has been to invent an automaton, or self-acting instrument, for calculation, which alone can deserve the name of a calculating machine. The first attempt of this kind was made by Blaise Pascal, in 1640. His machine performed addition and subtraction mechanically; but it was so difficult to work, and the mechanism so imperfect, that it was soon discarded and forgotten. A similar destiny attended a machine for adding and subtracting, invented in England by Samuel Moreland, in 1673. His other mathematical instrument is nothing more than an adaptation of Napier's scale to circles for multiplication and division. The defects and insufficiency of these two inventions of Pascal and Moreland gave rise to subsequent endeavours to improve them. Lepine in 1725, and Hillorin de Boistissandeau in 1730, were not more successful than their predecessors; nor did Gersten's invention, submitted to the Royal Society of London in 1735, afford any greater satisfaction.

In Italy, in 1709, Polenius tried his skill on a machine of this kind, but produced only a coarse unsightly abortion, encumbered with weights, that was far inferior to those which had preceded it. In all these cases the aim of the inventors was only to work addition and subtraction. Leibnitz sought to extend the operations of an arithmetical calculator to multiplication and division. The plan of his machine was submitted to the Royal Society of London in 1673, and met the approbation of the society. A similar honour attended it a short time afterwards from the Academy of Sciences at Paris. But, despite the approbation of those celebrated learned bodies, the plan which looked so promising on paper proved impracticable in execution. Leibnitz laboured hard during his whole life to bring his scheme to perfection, expended vast sums upon it, and yet effected nothing. Death carried him off, and his work remained unfinished and forgotten. In 1727 Leupold promised to publish to the world the plan of a machine that should perform addition, subtraction, and multiplication; he died, leaving behind him only a few fragments of his plan. After this it seems that no further attempts were made for a long period, until, in the year 1799, a minister of Wirtemberg, named Hahn, came forward with a new machine, which, however, attracted no attention, as it was found to commit serious errors in arithmetic: its internal structure remains unknown, as does also that of a faulty instrumen presented to the Academy of Sciences in Gottingen, by Muller, 1786.

The machine constructed by Mr Thomas Colmer in 1820, was a retrograde step in this branch of science.

In the year 1821, Mr. Babbage of London, undertook to construct a machine for Government, which should by mechanical means form tables of progression for the use of surveyors. A portion of this machine, forming a progression up to five figures, was complete—17,000*l.* had been expended on it already, and to perfect the entire work would have required twice as much more; consequently, in 1833, the project was abandoned, and it is not probable that the costly machine will be brought to a perfect state.

The fragment or member alluded to may be seen at the inventor's. Mr. Babbage is at present occupied with the plan of a machine which is to perform mechanically all the operations of algebra. Already he has 30 plans extant; every friend of science must heartily wish that the inventor may be more successful with his new project than he was with the previous one. We come now to speak of the recent successful attempt before alluded to. For the last two years, Dr. Roth, of Paris, has been engaged in the construction of arithmetical machines, and the success that has attended his efforts hitherto, proves he has accomplished his scheme for performing automatically all the operations of arithmetic, from simple addition, subtraction, multiplication, and division, to vulgar and decimal fractions, involution and evolution arithmetical and geometrical progression, and the construction of logarithms, with ten plans of decimals. The machine in its present state works addition, subtraction, multiplication, and both kinds of progression, quite mechanically, In division alone the attention is required to avoid passing over the cipher. The arithmetical progression is of vast importance, as it operates from one farthing to millions of pounds sterling; and when we consider the variety and utility of the functions performed by a small instrument, not more than a foot wide, and its comparatively insignificant price, we cannot but congratulate the inventor on his decided success in the results hitherto obtained, and express our cordial wishes that he may meet with every encouragement to persevere in his highly interesting and important labours.

Mr. Wertheimber, the proprietor and patentee of this invention, has two descriptions of these machines—a larger one which performs sums in addition, subtraction, multiplication, and division; and a smaller, which performs addition and subtraction only. These machines have been submitted to the inspection of several gentlemen eminent for their scientific attainments, all of whom, particularly Mr. Babbage, have expressed the most unqualified admiration at their unparalleled ingenuity of construction. Mr. Wertheimber had the honour of an introduction to the Royal presence, at Windsor Castle, on Wednesday, the 6th inst., when both Her Majesty and Prince Albert were graciously pleased to express their approbation of the machines, and to order two of each sort to be supplied for their use.—*Times.*

STEAM NAVIGATION.

A war steamer has been just built and completed for sea at New York for the Emperor of Russia. She is 2468 tons burden, and is called the Kamtschatka; on trial it was found that under steam only she made nine knots, and with the aid of some of her canvass 13 knots an hour; she has 600 horse power; her spar deck is 240 feet in length, on which she has two ten-inch with two eight-inch hollow shot guns (Paixhans), and 10 36-pounders; she is built wholly of American wood and metal, at a cost of 400,000 dollars.

The Cairo, a small iron steamer, belonging to the Oriental and Peninsular Company, has arrived in our waters, and has, during the week, made several experimental trips, the result of which has been, that, for speed, she can beat any of the steam-vessels which ply between this port and the Isle of Wight very considerably. On Monday last she proceeded hence direct up the Medina to Newport Quay, to the amazement of those along the river, who never saw a steamer there before. She did the distance in one hour and twenty minutes. The engines of the Cairo are complete models; they occupy a space of only three feet by six. *Hampshire Telegraph.*

Improved Feed Apparatus for Steam Boats.—For the purpose of working the force-pumps to suppply the boilers with water when the engines are stopped, Messrs. Penn and Son have introduced into the "Father Thames" steamer, a small engine (about half horse power) occupying a space 15 by 12 inches, driven by the steam which would otherwise be blown off from the safety valve, when the engines are at rest.

The Devastation Steam War Frigate.—This fine vessel which was recently launched from Woolwich Dock Yard, has been fitted by Messrs. Maudslays and Field, with their patent double cylinder engine, (drawings and description of which are given in the 3rd vol of the Journal, p. 73,) and the apparatus for connecting and disconnecting the paddle-wheel, lately patented by Mr. Field; this apparatus is worked with the greatest ease and simplicity. The power of the two engines is 400 horse, and the armament consists of two 10 inch, and four 32 pounder guns placed on swivels, and revolving on circular turn plates let into the floor of the deck. An experimental trip was made on Tuesday the 19th ult, when the vessel attained an average speed of 11½ miles per hour.

ENGINEERING WORKS.

Aberystwith Harbour.—The progress which the works at this harbour have made during the present year, has been both extensive and satisfactory. The length of the pier having been extended seaward 41 yards. Its present length is 261 yards, and it is expected by this time twelvemonth the remaining 39 yards will be completed, which will carry out the pier to its intended length 300 yards. We are glad to state that as the pier is extended seaward, the depth of water at the entrance is found to increase considerably, the heavy weight of the sea being broken on the seaward side makes the inner harbour to be in a perfectly quiet state during the heaviest seas, and the most stormy weather. It is now found that as soon as vessels pass the end of the pier they are in perfect safety. No greater proof can be given of this than the ease and safety with which the great American timber laden ships have passed in and out during the present season. On Saturday last his Grace the Duke of Newcastle and family visited the works, and expressed themselves highly pleased with the progress made since their visit last autumn.—*Carmarthen Journal*, Oct. 1.

South Foreland Light.—The original tower, which was among the first erected in England, is now under the process of demolition, being already almost levelled to the foundation. This tower is said to have been built in the reign of Charles II., and must consequently, have experienced the devastating influence of time for about a century and a half. The original light was coals burnt upon the flat roof of the old tower, which was supplanted in 1793, when the modern one was built for 15 oil lamps. There is also a lower light-house, to enable the mariner, in time of danger, to keep the two lights in a line, and thereby avoid the Goodwin Sands. The object of the Trinity-house, who purchased the property of Greenwich Hospital, in taking down this venerable tower, is to adopt a similar light to the one on the opposite coast, at Cape Grinez, which is found to answer better and more powerfully than those already in use. These ameliorations for the safety of lives and security of property are highly commendable in this body. The height of both cliff and tower will, it is supposed, be about 400 feet above the level of the sea.—*Canterbury Journal.*

Venice.—A bridge is about to be constructed at Venice, intended to unite that celebrated city with the Continent, and to connect it with the railway to Milan. The management of this gigantic undertaking has been delivered into the hands of the engineer Antoine Busetto Pitich. The expense is estimated at 4,830,000 livres Austrian. The bridge will also contain an aqueduct, intended to supply Venice with fresh water, which has hitherto been supplied in boats from the Continent, the city being unprovided with wells and fountains, and having but very few cisterns.

The Athlone Bridge.—This work is progressing wondrously, and the operation by which the workmen are enabled, with perfect impunity, to proceed with the excavations now several yards below the bed of the river, is a subject well worth the attention of the lover of the arts and sciences. By the simple efficacy of a steam-engine of twelve horse power, two large pumps, sunk within the area of the excavation, are set in motion; to these is appended by an air joint a tail which can be extended to any necessary depth, the pumps still remaining in their original position. By this process the accumulating water of springs and leakages, inseparable from a work of this nature, is drawn up and transported to a vast distance, over the heads of the operatives, through wooden troughs or conduits, into the Shannon; and thus an agency superior to the principle that causes its irruption, almost constantly acting upon that element, the men are free from the embarrassment consequent on its aproaches, and the works are made to progress without any material impediment.—*Athlone Mirror.*

Artesian Well at Southampton.—The works of the Artesian well on the common are now proceeding very favourably: the contractors have got to the depth of 430 feet. Should no untoward accident happen, it is expected the works will be completed by the beginning of next summer.—*Hampshire Telegraph.*

The River Thames.—The accurate survey of the river Thames, from Staines to Yantlet-creek, which was undertaken some time ago under the authority of the corporation of London, has been just completed. The following official men were engaged in the survey:—Mr. James Walker, the engineer; Captain Bullock, R.N.; Mr. Charles Pearson, the city solicitor; Captain Fisher, R. N., principal harbour-master of the port of London; Mr. Nathaniel Saunders, the water bailiff; Mr. Stephen Leach, the clerk of the works to the Thames Navigation Committee; and the harbour-masters of the port of London in their respective stations. It is believed that the report which will shortly be made upon the important subject of the improvement of the Thames by Mr. Walker and Captain Bullock, will lead to the adoption of a plan of improvement of immense magnitude, and calculated to render service in a great variety of ways.

NEW CHURCHES, &c

TRINITY CHURCH, NOTTINGHAM.

On Wednesday, Oct. 13, the interesting ceremony of consecration was performed by the Right Rev. the Lord Bishop of Lincoln, at the New Church recently erected on Burton Leys. This building, which has been erected at an expense of £10,000, is a perfect specimen of architectural excellence; the simple and chaste appear to have been studied in its planning; and the grace and beauty of its tall and tapering spire have seldom been surpassed. It may not indeed emulate in grandeur and magnificence the vast piles of masonry reared by the pious zeal of our ancestors—

> "Where, through the long-drawn aisle and fretted vault,
> The pealing anthem swells the note of praise."

but for elegance of design and beauty of execution it may challenge comparison with the most admired of modern structures.

The nave is internally 80 feet long, by 54 feet wide, 30 feet high at the side walls, and 35 feet 6 inches high in the centre. It is approached at each angle through roomy lobbies, or porches; those at the West end contain the stair-cases to the galleries. The seats in the church are placed transversely, and are separated into three divisions, or ranges. The greatest part of those in the centre division are unenclosed and free. Those on each side are in pews, a few of which remain without division for the accommodation of large families; the majority alternately divided, so as to form pews of various dimensions, to accommodate respectively four, five, or six persons. The access to the pews, &c., is from four aisles, extending the whole length of the nave, from East to West, and connected with each other at the East and West ends by broad aisles, at right angles.

The galleries are spacious, and extend the whole length of the North and South sides, approached from the South-west and North-west entrances. There are four longitudinal ranges of pews, and a raised commodious seat against the walls in each gallery. The west gallery has a range of front pews only; the remainder is entirely appropriated to children's sittings, and space for an organ. This gallery has a separate communication from the outside, through the tower; and the inconvenience so often experienced in the departure of the congregation, is entirely obviated by the position, size, and number of the entrances.

The nave is lighted by five triple lancet windows on each side. At the west end is the tower, 14 feet square, which is opened to the nave by a lofty Gothic arch. The lower part is occupied by open seats, and the font, and the upper part is divided into ringing room, clock room, &c. The chancel is at the east end 25 feet wide, and 19 feet deep, and equal in height to the nave, lighted by a large rose, or wheel window in the centre, and a single lancet window on each side. An arch, similar to that of the tower, marks the division between the nave and the chancel. On the right and left are pews for the minister's family, and the communion is enclosed by a low Gothic iron railing. The floors of chancel and tower are elevated one step above the nave, and the communion another step in addition.

On the north side of the chancel is a vestry, communicating with the lobby and chancel; and a corresponding room on the south is appropriated for the warming apparatus.

The pulpit, reading desk, and clerk's pew are centrally situated, near the archway, at the east end of the nave.—The preacher is not only seen by, but faces the whole congregation, except those occupying the two pews in the chancel.

The pews have sloping backs, broad seats, and are 2 feet 11 inches wide, and the whole internal arrangement comprehends those essential requisites—space, comfort, and convenience; the absence of which, in modern churches, is too frequent.

The total accommodation in the church is 1,215 sittings, 415 of which are free.

The roof is supported by nine strongly framed trusses, alternately resting upon stone corbels. The inconvenience and unsightliness of horizontal tie beams (especially in so wide a span), is avoided, by placing the tie beams above the wall plate level, and connecting strong principal rafters at the feet of beams inclining upwards to, and abutting upon the tie beam in the centre. This peculiar construction allows the ceiling to assume the same inclination, which form is so conducive to the conveyance of sound, and effectual ventilation; for which latter purpose three large circular ventilators are provided at the intersection of the principal timbers. The whole of the wood-work of the roof below the ceiling line, is moulded and painted in imitation of oak; and the longitudinal ceiling beams divide the whole into compartments.

The details of the interior are designed with strict regard to durability and economy; due care having been taken that the eye be not offended by incongruities of style. Ornament is sparingly introduced, and in those parts only where it conduces to the general harmony and effect.

The exterior is cased with stone, and the style of architecture adopted is that called *early English*, used in this country during the 13th century. The sides are divided into five compartments, by substantial weathered buttresses, canted at the angles, and terminated at the level of parapet by sharply pointed hoods. Each compartment is filled with a triple lancet window. The centre light, higher than the side ones, is 20 feet high. The jambs and mullions are faced by the characteristic column, with its base and capital. The door-ways are deeply recessed with a trefoil over the head, covered by a pyramidal drip moulding. The staircases at the north and south-west angles are necessarily higher than the corresponding entrances at the opposite end of the church, but do not attain the same elevation as the flanks, in order to show as much of the base of the tower as possible; they are lighted by single lancet windows, facing the west. The parapet of the nave and chancel is supported by a corbel table, and the base is in two divisions, each terminated by a deep weathered horizontal moulding. The chancel is lofty, the roof being a continuation of that of the nave. At the east end is a trebly composed window; in the centre of the head is the large wheel before mentioned, which alone is glazed (with coloured glass), all the lower part being blank, to prevent the admission of too strong a glare of light behind the preacher; the jambs, mullions, tracery, &c., being sufficiently recessed to relieve the plainness of the end. The double rectangular weathered buttresses of the chancel are terminated by octangular pinnacles, and the blank spaces in the gable and sides are relieved by quatre-foils. The tower at the west end has substantial double buttresses at each angle, and a triple lancet window of the same dimensions as those in the flanks, which is seen through the archway from the church. A pointed arched corbel table supports the string course. Another compartment is formed by a string course at the level of the ridge of the roof.—From this point upwards is the clock room, with a circular space for dial on every face, and marked also by a weathered string course; at this point the tower is sloped off by weathered angles to an octagon, and four pinnacles surmount the buttresses. The belfry is lofty, and each face is pierced by a lancet window, in unison with those before described. Each angle of the tower is terminated by a pinnacle, and the parapet is pierced. Above this rises the spire, ribbed at the angles, with three tiers of openings and hoods. The whole height from the ground to the apex of the spire is 172 feet. The architect is Mr. H. I. Stevens, of Derby.—*Nottingham Journal.*

Risley Church.—This picturesque little church, having undergone considerable repairs and enlargements, was re-opened for divine service on Sunday, the 3rd of October. Alterations have been effected according to the designs and under the superintendence of Mr. Stephens, architect, Derby. A capacious aisle has been erected on the north side, connected with the body of the church by two gothic arches, capable of accommodating about 120 persons, of which 61 sittings are free and unappropriated. A beautiful window, representing the two great apostles, St. Peter and St. Paul, painted by Mr. Warrington, of London, has been placed in the chancel.

The sum of £1,100 has been subscribed by the parishioners of Tettenhall in aid of the extensive alterations and repairs which are being made in the church of that parish.

Woolwich.—The first stone of the new Scotch church at Woolwich was laid on the 8th of September, with a very imposing ceremonial, there being present above 500 of the military members of the church. Colonel Dundas officiated on the occasion. The church is to contain 1000 sittings; the dimensions of the interior in the clear are 76 ft. 3 in. by 51ft. 6 in. It is of the Norman style with a spire. The contract for the carcase has been taken by Mr. Jay for £1850. Mr. T. L. Donaldson is the architect.

St. Pancras.—A new church is about to be built in Gordon Street, St. Pancras, to contain 1200 sittings. Mr. T. L. Donaldson, the architect, has designed the front in the style of the "Renaissance." It consists of 4 pilasters raised upon a lofty stylobate. The doors are circular headed, and are between the outer pilasters on each side, the window being the centre object, divided in the middle by a column, and circular headed like those of Bramante. The whole is surmounted by a regular entablature, pediment and bell tower. The committee have accepted Messrs. Haynes' tender to erect the carcase for £2825.

The Temple Church.—Probably the public may not be generally aware of the extensive reparations which this ancient building is now undergoing. The object which the society have in view is the complete restoration of the church to its former state—to that in which it was originally completed. The church is a mixture of the Norman and early English styles, and has generally been considered the best of the few round churches of which this country can boast. The interior has been completely stripped of all its former ornaments and monuments, of which those of sufficient value, and which it is desirable should be retained, are being brought into a state which will harmonize with the character of the rest of the building. The ceiling of the choir and side aisles of the church, and particularly of the eastern portion, which is a fine specimen of early English, was originally painted and embellished in ornamental work of a very high character. The effect of this, which can already be partially seen, will be very beautiful and striking. It may also be in the recollection of some, that in the large circular tower next to the entrance of the church were several columns of the Corinthian order. These from possessing a rather dilapidated appearance, arising from their antiquity, will now be restored to the highly polished marble pillars of the time of the Templars. There are many other parts of the building to which we could wish to draw attention. The figures of the old Templars will be preserved, as also those in the porch outside the entrance. The church has already been closed for about a year and a half, and it is expected it will take full that time in addition before the work is completed. The Temple Church will then rank as one of the finest buildings of the metropolis, carrying with it, as it does, the respect due to age.

MISCELLANEA.

The Bude Light.—The new system of lighting and ventilating by means of this improved light was most successfully shown at Christ Church, Albany-street, Regent's-park, on Sunday, 1st ult., at the evening service, a more perfect illumination having been produced by two ornamental lustres (similar to those used in the House of Commons) than by the 72 argand burners previously used there. The perfect ventilation of the church was likewise effected by means of flues ascending from these lustres through the ceiling into the open air, which carried off all heat, noxious products of combustion, as well as air vitiated by respiration, so prejudicial to health in close or crowded apartments. These advantages appear to be peculiar to a light of this power, as lights of a lesser power must be placed at such distances from the ceiling, in order to illuminate the lower parts of a room or building, as would render impracticable any attempt to carry ventilating flues from each light; independent of which, the glare from a multiplicity of naked lights is not only offensive but injurious to the sight. These improvements were adverted to in a very appropriate manner from the pulpit by the rector, Mr. Dodsworth, to whom, as well as to the Hon. Captain Maude, one of the churchwardens, much credit is due for their exertions in providing a remedy for evils of this nature, which had been much complained of in this church—evils to which all unventilated apartments must be more or less liable.

Gigantic Chimney.—A chimney of extraordinary dimensions is being built at St. Rollox chemical works, and will, when completed, be elevated upwards of 600 feet above high-water level at the Broomielaw; it is founded upon a bed of solid sandstone rock, 20 feet below the surface of the ground; the diameter of the outer chimney is 50 feet at the foundation, 40 feet diameter at the surface of the ground, and will diminish in one unbroken curved line or "batter" to a diameter of 14 feet 6 inches, when it will have attained an altitude of from 420 to 430 feet. The inner chimney is a cylinder of sixteen feet diameter, rising perpendicularly to a height of 260 feet. This inner chimney is unconnected with the outer one, but comes very nearly in contact at its termination, allowing only space for the expansion arising from the temperature. The bricks used in the work are a composition of common clay and fire-clay, containing a small portion of iron ore.

New Railway Signals.—A new system of signals for railroads has been invented by Mr. Hall, the managing director of the Eastern Counties Railroad, intended to supersede the red and white flags now carried and exhibited by policemen at certain distances, and which have been sometimes found inadequate to the purpose. The new signal, which Mr. Hall calls the "Panel or fan signal," has, when put in operation, the appearance of an upright post of about 12 feet high, surmounted by a piece of woodwork resembling in shape that of a closed fan. Where they both join is a strong iron frame. In the upper woodwork three panels are encased, which are worked by machinery, and when brought down to the iron framework before described, assume the appearance of a crimson quadrant of a span sufficient to be visible in a straight line for two miles. When a train is due to start, the three panels are lowered. As soon as it has started and reached the signal, the man in charge of it sets in motion a piece of machinery, which gradually works up the three panels in 15 minutes, and the signal at the end of that time presents its original appearance. By this arrangement engine-drivers will be able accurately to calculate the time which has elapsed since a train has passed; one panel indicating five minutes, two ten, and three a quarter of an hour. The new signal will, in a few days, be put in operation on the Eastern Counties Railway.

Wear of Granite Pavement.—During 17 months, the following was the relative wear of pavement made of the granites named, laid down on the Commercial-road in London:—Guernsey, 1·0; Herm (an island close to Guernsey), 1·19; Budle (a Northumberland whinstone), 1·316; blue Peterhead, 2·08; Heyton, 2·238; red Aberdeen, 2·524; Dartmoor, 3·285; blue Aberdeen, 3·571. These differences are very considerable, and are, in a great measure, to be attributed to the mineralogical structure of the stone, granite being composed of at least three species, mica, feldspar, and quartz, of which the quartz is the hardest and the mica the softest. Permeability to wet is also a rapid cause of disintegration, especially in conjunction with frost. It is melancholy to see many of our public edifices rapidly hurrying to decay, from the bad qualities of the stone employed in their erection. Great attention should be paid to the qualities of the stone, in selecting railway blocks; although the opinion of railway engineers is now most inclined for timber bearings. Leaving out the question of first and last cost, longitudinal timbers with iron cross trees, decidedly make the most pleasant road; and the effect of this, not only on the passengers, but the engines and carriages will, in our opinion, put the ultimate cost on one side. We shall not easily forget the smoothness of the Great Western Railway, which was so evident as to admit of no doubt, although, when we went on it, we were much prejudiced against it, from what we had heard; our prejudices were soon dispelled.—*Railroad Journal.*

Discovery of Ancient Pavement.—In addition to the ancient paintings discovered lately by Mr. Devon, in the Chapter-house Record-office, he has found under the present wooden floor a pavement composed of the ancient Norman tile, which is characterized by figures in gold, burnt in brick. The figures on these tiles are very beautiful and various. Among them are the arms of England, as borne in the thirteenth century, when the building was erected, lions placed back to back, female figures seated on chairs with hawks on their wrists, David playing on the harp, musicians playing on the violin, and various other patterns, making altogether a most magnificent groundwork. The art of preparing similar tiles has been recovered, and fac-similes of those in the Chapter-house are now being manufactured in England for the Temple Church.

Absorbing Wells.—The Council General of the Department of Isere has voted the sum of 1800 francs for the application of absorbing wells to the drainage of the numerous ponds and marshes in the neighbourhood of Bourgoin. The principal engineer of the mines, Gueymard, on whose report the grant has been made, is to superintend the first experiments. If, as it is believed, there lies between the diluvial soil and the turf or peat of these marshes a stratum of clay, it will only be necessary to penetrate through it to attain the sand and diluvial gravel, which form the subordinate strata, and the success of the undertaking will then be placed beyond all doubt. The drainage of the bogs of *Verpilliere*, *Bourgoin* and *La Tour du Pin* will of course follow; and those of Dauphiny, which up to this period have been so unprofitable, will develop a new source of riches for a country, which has hitherto only considered them as a serious inconvenience. Should the absorbing wells have the success which we anticipate, the turf districts of Bourgoin will assume, in regard to Lyons and Grenoble, the same importance as those of Menecy and the department of the Eure have held in relation to Paris and Rouen. Every one is aware that turf has the property of carbonization like wood.—*Courrier de Lyons.*

New Locomotive.—M. de Ridder has completed a new locomotive in which he has found means to turn to account the quantity of steam which is suffered to escape in other locomotives. The result of this improvement is a great saving of fuel, besides diminishing the weight. The dimensions of these new locomotives are such as to hinder the use of them on iron railways. Perhaps M. de Ridder had in view the realization of his projected railway by St. Nicholas. However that may be, we have examined attentively this machinery in all its parts, and it appears to us to be one of the most satisfactory of the kind hitherto made in Belgium.—*Brussels Paper.*

China Grass-cloth.—If any person will be at the trouble of cutting a leaf from an aloe plant, which is reared and encouraged as an exotic in this country, he will, upon close inspection, detect a course of long white fibres, possessing considerable tenacity. These, when taken from the fleshy part of the leaf, and placed together by themselves, will exhibit a very beautiful clean hemp, corresponding precisely with the material of which the linen called China grass cloth is composed. The aloe grows wild and in great abundance throughout China, and the people of that country have turned it, as they do everything else, to a profitable account. The flax which constitutes the fishing lines known under the name of Indian twist, but which is in reality a Chinese production, is manufactured from the same identical commodity. There are many Chinese inventions, at present retained as a monopoly by the above people, which are easily capable of being arrived at by those of other countries, if proper attention and a very moderate share of curiosity were bestowed upon the subject.

United States Bank Building.—The extinction of the United States Bank leaves that magnificent edifice in the hands of the assignees, as a part of its available property. To what use it will now revert, is matter of conjecture. This splendid pile was commenced in 1819. It was five years in building. The original expense was 500,000 dollars, but when the old bank charter expired, it was sold to the present institution for 200,000 dollars. The building is purely of white marble, and both inside and out scarcely any wood is to be seen. From Chestnut-street the bank is reached by a lofty flight of marble steps. It presents a splendid front of 80 feet in width, with eight Doric columns, four feet six inches in diameter, and 27 feet high. The building is 161 feet long, and the porticoes at each end correspond. Both internally and externally the style and finish are equally massive and beautiful. The principal banking room is 48 feet wide and 81 feet long, with an arched ceiling, supported by rows of marble columns. Aside from this, there are a multitude of apartments, for the use of the different officers and directors, as well as for engravers and copperplate printers. It is admired for its beautiful proportions, as well as for its imposing size and classic architecture.—*Times.*

EXTRA HIGH TIDES OF THE RIVER THAMES.

The following table shows the heights of extraordinary high tides for the last 20 years, by which it will be seen that the unusual high tide of the 18th ult. was the highest:—

		ft. in.	ft. in.
1821	Dec. 28	27 1½	2 10½
1824	Dec. 23	27 3	3 0
1827	Nov. 21	27 5¼	3 2½
1834	Jan. 29	27 2	2 11
1836	May 2	26 10	2 7
1841	Oct. 18	27 7	3 5

The total heights are those of the rise of tide above the sill of the Blackwall entrance to the West India Docks, which is 24 feet 3 below H. W. Trinity standard, and 6 feet 5 inches below L. W. of the same standard. The other column shows the rise of tides above zero, or Trinity High Water Mark.

Thames Tunnel.—Considerable fears were entertained during the late flood, that this great work would have filled with water, the top of the shaft at Wapping being only three feet above the level of the surrounding ground—fortunately the water subsided without in this case doing any damage. The shaft on the Wapping side is already sunk to the level of the excavation, under the bed of the river, of which only seven feet and a half remain to form the junction, so that in about another month the Tunnel itself will be completed.

Plate Glass.—This article is of late being introduced for purposes some time back little thought of, it is now manufactured as thick as ¾ of an inch, and is used unpolished in floors where a light is required to be thrown down on a story below, even as a substitute for coal plates we have seen it used, when the top surface is ground.

Carpenters' Mallet.—An improvement has been introduced by encasing the mallet with a ferule or case of iron ⅛ to ¼ of an inch thick with the wooden ends protruding, thus a small mallet about 3 by 2 inches on the end is equal in weight to the largest size mallet made entirely of wood.

A Steamer launched at Canada.—On the 13th of September, a splendid new Government steamer, constructed by Mr. J. Tucker, Admiralty Architect, was launched from the building yard of Messrs. Millar, Edmonstone, and Allen, at Montreal. The day selected for the launch was the anniversary of Wolfe's victory. The length of the Sydenham between perpendiculars is 170 feet, the breadth 27 feet, and the depth of hold 16 feet 9 inches. She is to carry two 68-pounder guns, and be propelled by two engines of 110-horse power each. On examining the vessel after the launch, it was found she had only settled one-eighth of an inch, a result highly flattering to the skill and talent of the architect.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 24TH SEPTEMBER, TO 28TH OCTOBER, 1841.

Six Months allowed for Enrolment.

JEAN LOUIS ALPHONSE PETIGARS, of Brewer-street, Golden-square, gentleman, for "*improvements in the construction of presses.*" (Being a communication.)—Sealed September 24.

HUGH LEE PATTINSON, of Bensham Grove, Gateshead, Durham, manufacturing chemist, for "*improvements in the manufacture of white lead, part of which improvements are applicable to the manufacture of magnesia and its salts.*"—September 24.

FREDERICK BROWN, of Linton, Bedford, ironmonger, for "*improvements in stoves or fire-places.*"—September 24.

THEODORE FREDERICK STRONG, of Goswell-road, engineer, for "*certain improvements in locks and latches.*"—September 28.

SAMUEL STOCKER, of Barford-street, Islington, engineer, and GEORGE STOCKER, of Birmingham, cock-founder, for "*improvements in machinery and apparatus for raising, forcing, conveying, and drawing off liquids.*"—September 28.

JOHN WHITE, of Burton-in-the-Wolds, Leicester, farmer, for "*an improved horse hoe, for use in agricultural pursuits.*"—September 29; four months.

JOSEPH MILLER, of Monastery Cottage, East India Road, engineer, for "*an improved arrangement and combination of certain parts of steam engines, used for steam navigation.*"—September 29.

EDWARD WELCH, of Liverpool, architect, for "*certain improvements in the construction of bricks.*"—September 30.

WILLIAM HIRST and JOSEPH WRIGHT, of Leeds, in the county of York, clothiers, for "*certain improvements in the machinery for manufacturing woollen cloth, and cloth made from wool and other materials.*"—October 7.

THOMAS WELLS INGRAM, of Birmingham, manufacturer, for "*improvements in shears, and other apparatus for cutting, cropping, and shearing certain substances,—parts of which said invention being a communication from a foreigner, residing abroad.*"—October 7.

JOSEPH CLISILD DANIELL, of Tiverton Mills, Bath, for "*improvements in the manufacture of manure, or a composition to be used on land as a manure.*" October 7.

MATTHIAS NICOLAS LA ROCHE BARRE, of St. Martin's-lane, Middlesex, manufacturer of cotton, for "*an improvement in the manufacture of a fabric, applicable to sails and other purposes.*"—October 7.

MARCUS DAVIS, of New Bond-street, optician, for "*improvements in the means of ascertaining the distances vehicles travel.*"—October 7.

THOMAS BIGGS, of Leicester, merchant, for "*improvements in securing hats, caps, and bonnets, from being lost by the effects of wind or other causes.*"—October 7.

BENJAMIN AINGWORTH, of Birmingham, gentleman, for "*improvements in the manufacture of buttons.*"—October 7.

JOHN JONES, of Smethwich, Birmingham, engineer, for "*certain improvements in steam engines, and in the modes or methods of obtaining power from the use of steam.*"—October 7.

JOHN HARWOOD, of Great Portland-street, gentleman, for "*an improved means of giving expansion to the chest.*"—October 7.

WILLIAM NEWTON, of the Office for Patents, 66, Chancery-lane, civil engineer, for "*certain improvements in engines to be worked by gas, vapour, or steam.*" (Being a communication.)—October 14.

MOSES POOLE, of Lincoln's Inn, gentleman, for "*improvements in fire-arms.*" (Being a communication.)—October 14.

EDWARD MASSEY, of King-street, Clerkenwell, watchmaker, for "*improvements in watches.*"—October 14.

HENRY ROSS, of Leicester, worsted manufacturer, for "*improvements in combing and drawing wool, and certain descriptions of hair.*"—October 15.

JUNIUS SMITH, of Fen-court, Fenchurch-street, gentleman, for "*improvements in machinery for manufacturing cloths of wool and other fibrous substances.*" (Being a communication.)—October 20.

JOHN BRADFORD FURNIVAL, of Street-Ashton, farmer, for "*improvements in evaporating fluids, applicable to the manufacture of salt, and to other purposes where evaporation of fluids is required.*"—October 20.

HENRY DAVIES, of Birmingham, engineer, for "*certain improved tools or apparatuses for cutting or shaping metals and other substances.*"—October 21.

THOMAS JONES, of Varteg Forge, near Pontypool, Monmouth, engineer, for "*improvements in the construction and arrangement of certain parts of marine and stationary steam engines.*"—October 21.

JAMES WHITWORTH, of Bory, in the county of Lancaster, manufacturer, and HUGH BOOTH, of the same place, machine maker, for "*certain improvements in looms for weaving.*"—October 21.

MARTYN JOHN ROBERTS, of Brynycairau, Carmarthen, gentleman, and WILLIAM BROWN, of Glasgow, merchant, for "*improvements in the process of dyeing various matters, whether the raw material of wool, silk, flax, hemp, cotton, or other similar fibrous substances; or the same substances in any stage of manufacture; and in the preparation of pigments or painters' colours.*"—October 26.

THOMAS HOLCROFT, of Nassau-street, Middlesex, gentleman, for an "*improved portable safety boat or pontoon.*"—October 28.

TO CORRESPONDENTS.

An Architect accuses us of discontinuing to give the particulars and amount of contracts of New Churches and Public Buildings; we can assure him and the Profession generally, that we have every disposition to insert any announcement that may be sent us, but we find the architects so backward in forwarding the particulars required, that it is impossible for us to give the information, although we are most desirous to do so.

We have received another communication on Competition, requesting us to announce the amount of contracts of those Buildings which far exceed the limited amount of the conditions of Competition; we are not in possession of them, but if any information be forwarded us on the subject, we shall be happy to announce it.

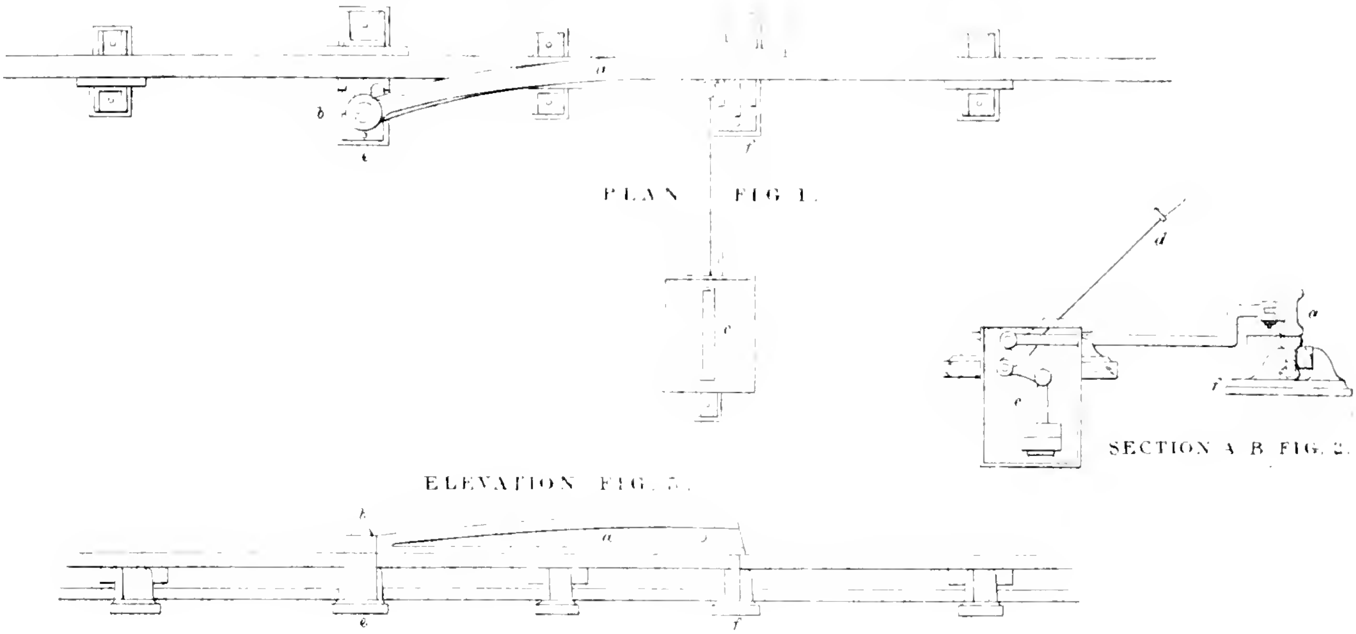
The next number will conclude the fourth *volume.*

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," No. 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

LONDON & BIRMINGHAM RAILWAY, SELF-ACTING CHOCK



PLAN FIG. 1.

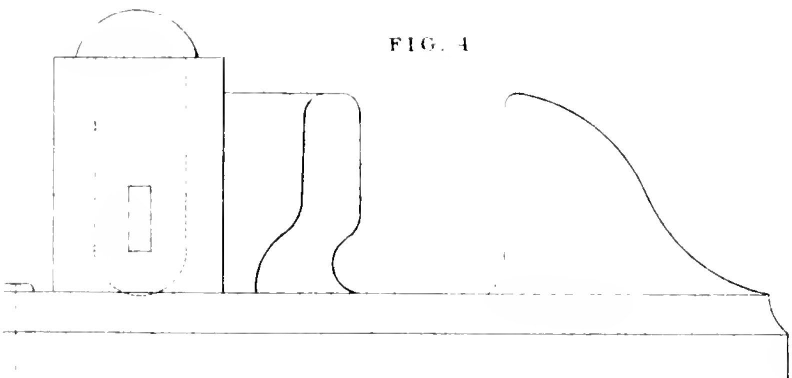
SECTION A B FIG. 2.

ELEVATION FIG. 3.

SCALE TO FIGS 1 2 & 3

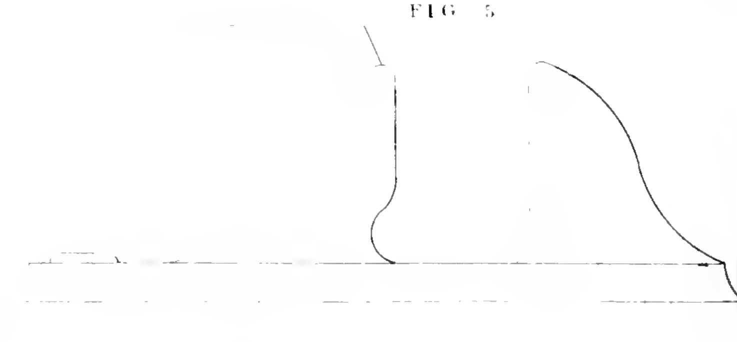
12 6 0 1 2 3 4 5 6 Feet

FIG. 4



Enlarged Elevation of Chair e

FIG. 5

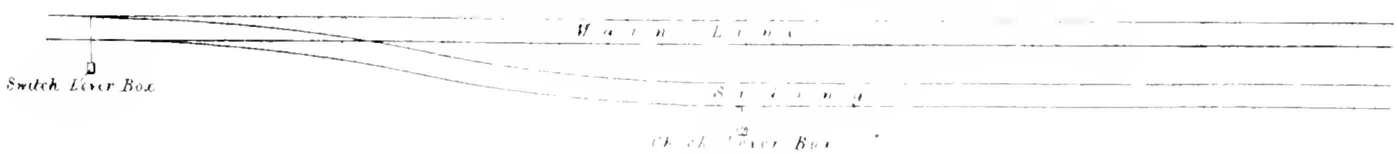


Enlarged Elevation of Chair f

SCALE TO FIGS 4 & 5

Inchs 12 6 0 1 Foot

PLAN SHEWING POSITION OF CHOCK



LONDON AND BIRMINGHAM RAILWAY.

SELF-ACTING CHOCKS.

With an Engraving, Plate IX.

THE object of these chocks is to prevent carriages or other vehicles from being blown out of the sidings on to the main lines of railway, or from their being pushed out by inattention or carelessness, the consequences of which, especially during the night, have frequently been collisions of a more or less serious nature.

The chock *(a)* (forged out of a piece of railway bar) is placed upon one of the rails of the riding: the end next the switches, is turned back to the centre *(b)* from which it moves, the other end is formed to receive the periphery of the wheel, a balance weight contained in the box *(c)* is attached to the chock, and so hung as to retain it upon the rail; by means of the lever *(d)* the chock can be withdrawn from the rail, the chair *(e)* carries the centre pin *(b)*, and the chair *(f)* supports the chock when withdrawn from the rail. It is obvious that the wheels of a carriage, when pushed into a siding, will open the chock by pressing against its inner surface, and that when the wheels have passed, that the balance weight will return the chock upon the rail, and that no carriage can pass from the siding to the main lines until the chock is withdrawn by the handle *(d)*.

These chocks have been in use upon the London and Birmingham Railway upwards of 12 months, and are found to answer the purpose intended.

R. B. D.

KARL FRIEDRICH SCHINKEL.

IN this eminent individual, who died at Berlin on the 10th of October last, in his 61st year, architecture has lost one of its ablest professors and greatest ornaments an artist of whom Germany may justly be proud, and who was well entitled to the splendid funereal honours paid to him in the capital he had adorned with so many noble monuments of his taste and genius.

It was, we believe, the Foreign Quarterly Review, which first of all made the name of Schinkel known in this country, by calling attention to some of the principal works he had then executed, and speaking of them in terms of commendation, which, strange to say, so excited the wrath of Mr. Joseph Gwilt, that he thought proper—not at that time but a year or two afterwards, to attack the article in that periodical, and attempt to write down Schinkel. With that extraordinary exception, all that we have ever read or heard concerning Schinkel and his works, has been uniformly expressive of admiration. In fact, many of our readers, at least so we are willing to believe, must be well acquainted with his "*Entwürfe*" or published designs, for they ought to be in the library of every architect who can afford to purchase them.* He has been characterized as being the poet of architecture, who, instead of merely transcribing and copying the Greeks, has shown himself imbued with a kindred feeling, and has expressed himself as they would have done under similar circumstances.

Without pledging ourselves to admiration of all he has done—certainly not as regards his designs in the Gothic style—we scruple not to affirm that many valuable novel ideas and motives are to be met with in his works, although not to the extent that might have been, for he has repeated himself too frequently in many features, especially his doors, which are nearly on every occasion alike. However, reserving criticism of this kind for some other opportunity, when we may probably enter into description of some of the structures erected by him, we shall at present confine ourselves to such a biographical notice of Schinkel himself as we have the means of collecting from the sources just now at hand.

Karl Friedrich Schinkel was born at Neuruppin, where his father was "Superintendent," March 13th, 1781. By the death of that parent in 1787, he was left totally dependent upon his mother, who placed him in the Gymnasium or public school of his native town until the age of 14, when the family removed to Berlin. Having manifested a decided taste for drawing and designing, he there became a pupil of the elder Gilly, the architect, and afterwards of the son, Professor Gilly, to whose instructions he was in no small degree indebted for the liberal views he afterwards entertained of his art, as one affording scope for the exercise of invention, fancy and taste. The younger Gilly, however, died within about two years, and the completion of several buildings was in consequence entrusted to Schinkel. Not long after this period, he began to apply himself more to designing and to the study of architectural composition; also to making designs for vases, bronze work, ornamental furniture, and other things of the kind, wherein he could display taste, and which, although they do not exactly belong to the province of the architect, as it is usually defined, are not at all more alien from it than some others presumed to belong to his professional pursuits, notwithstanding that they have no connexion with art, and but very remotely with practical building.

At length he determined upon visiting Italy, and set out for that country in the spring of 1808, taking his route through Dresden, Prague, Vienna, and Trieste. After examining the antiquities of Istria, he passed over to Venice, thence proceeded to Florence and Rome, and in the following year to Naples and Sicily, returning through France, and reaching Berlin after an absence of two years. At that period the state of public affairs in Prussia was exceedingly unpropitious to his prospects in his profession, more especially in that higher department of it to which he aspired; and he therefore devoted himself for a while to landscape painting—partly views of some of the places he had visited, and partly original compositions, which he generally made the vehicle of his architectural ideas, introducing into them studies and designs of his own. These productions earned for him no small reputation, and by so doing they probably opened for him the career in which he subsequently obtained such universal celebrity. On the return of the royal family, he was commissioned to make designs for some alterations in the palace, and in 1810 was appointed *assessor* of the *Baudeputation* or Board of Works and Buildings, his duty being to give his advice upon matters of taste.

At the time of the Allied Sovereigns being in this country, he received an order from the King of Prussia to prepare designs for a Cathedral to be erected in the capital as a testimonial in honour of the military achievements so felicitously terminated. But although all the plans and drawings for this *Pracht-bau* were finished, it was considered more advisable to postpone the work itself indefinitely to some future opportunity.

Nevertheless, though he was doomed to disappointment in regard to the execution of that magnificent project, the restoration of peace was the epoch from which Schinkel's career as an architect may be dated. It was at that period his talents were first called into play, and important opportunities afforded them, almost uninterruptedly, for a series of years, during which he not only erected most of the finest of the public structures which now grace the capital of Prussia, but also many at Potsdam and various other places, besides numerous others for private individuals. To Schinkel, it has been observed, Berlin is indebted for a new physiognomy, one that imparts to it an original and peculiar character: and certainly his works, even the least successful of them give evidence of geniality, and of an inventive mind, less scrupulous as to following established precedents, than ambitious of forming precedents for others, and of extending the limits of the art. Among the earliest and certainly not the least successful of his works in the capital are the large Theatre, the Wachtgebaude, and the Museum. To these succeeded the Werder Church, Bauschule, Observatory, &c. &c. Of the buildings here mentioned, together with a great many others, the designs are given in his "Entwurfe;" and many of them are illustrated more copiously than is usual in works of the kind, not only by sections and plates of detail, but by perspective views both exterior and interior. The plates themselves are all in outline, nothing being shaded except the ground plans and solid parts of the sections, therefore those in perspective do not fully express the effect of the buildings themselves. All of them are beautifully drawn, —perhaps too delicately, for they certainly do not possess that vigour and spirit which are so captivating in some of the French architectural works *au trait*. The publication itself, however, has extended Schinkel's influence as well as his reputation, and has almost given rise to a new school of the art in Germany. Among his immediate pupils may be named, Stuler, Knoblauch, Burde, Menzel, Geisler, Strack, besides many others of rising talent in their profession. Among Schinkel's other publications is one consisting of a series of designs for furniture (Mobel-entwurfe), and "Entwurfe der Hoheren Baukunst," containing designs for the new royal palace, on the Acropolis, at Athens, for which, however, another site was chosen, and Gartner of Munich appointed the architect.

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* Such, however, is certainly not the case, for we know of one who borrowed them of a bookseller, under the pretence of keeping them if approved of, and then ordered him to send for them again, when it was discovered by marks left on it, that he had copied one of the plates for some particular purpose, on which account he had just then occasion for the work. However as the poor devil alluded to makes only a few thousands a year by his practice, it is not much to be wondered at that he should be obliged to borrow books of the kind, instead of purchasing them Another reason for the miserable creature's not keeping Schinkel's works might be that they reproach his own for the want of every merit the German architect displays.

AN ARCHITECTURAL NOTE FROM PARIS.

By George Godwin, Jun., F.R.S., &c.

If the same spirit which now seems to pervade all classes of the population there should continue to prevail, Paris will speedily become the most elegant city in the whole world. New *quartiers* are being built, old houses razed to the ground, fresh streets opened; her ancient glories protected and restored, the modern public monuments long in progress, completed with magnificence quite regardless of expense. No person who visits Paris with his eyes and ears open, can fail to observe how much more general are a knowledge and love of art there than in England,—how much more interest all matters connected with it appear to excite, how much more competent to judge in it the majority of persons are, and consequently how much reason there is that its professors should become numerous and eminent. The result of the free admission of the people to national monuments and works of fine art, and of the liberal encouragement afforded by the government to the arts of design, is becoming more evident every day, and is seen to be in most respects good. Something more than this it is true, is necessary to ensure the perfect happiness and well-being of a state, but with this just now the writer has nothing to do: he alludes to it simply to prevent any from supposing that he considers the encouragement of the fine arts the only one thing necessary, and to answer in some degree a remark which might be, in fact which has been made, namely, that as France is not more tranquil and prosperous, politically, than we are, this cultivation of the arts has been of little service, and is therefore not greatly to be desired. Depend upon it if it were not for this, France with her myriad population,—fermenting, unemployed, would be in a much worse state than she now is. Love of the fine arts amongst the people generally, is *one* of the anchors by which the stability of a state may be ensured.

Hardly a house is now erected, even in the back streets of inferior localities, without highly enriched dressings for the doors and windows, balconies of which the soffits are sculptured, cornices richly decorated. The pediments over windows are filled with foliage, every moulding is enriched; and figures and heads (in most cases effectively, and in many instances beautifully sculptured), ornament the piers, or the spandrells of arches. Ironwork of elaborate design fills the lower part of the window openings from the top of the building to the bottom, and this being partially gilded, aids materially the general effect. The *Cité des Italiens*, a building near the Boulevard des Italiens, designed by the brothers Kaufman, (the eldest of whom died prematurely), may be cited as a good example. The window dressings are exceedingly elegant, the general arrangement excellent, in fact as a whole it quite puts to shame any specimen of street architecture of which we can boast. The interior court displays much richness of fancy. The café adjoining this building and fronting on the Boulevard, is another instance, and presents a series of elaborately sculptured adornments over the whole of its two fronts. The frieze above the ground floor is especially worthy of examination. On the Boulevard Bonne-Nouvelle; in the new quarter towards the north, near the church of Notre Dame de Lorette; in the neighbourhood of the Madeleine; indeed in nearly every part of the city, other buildings might be instanced. Stone being used universally as the staple building material, the houses as all know, have an aspect of substantiality and permanence not to be attained with our 14 inch brick walls and compo adornments. The stone generally employed does not take a good face, being full of shell-holes and cavities, but nevertheless is of nice colour and seems to endure tolerably well. It is found necessary however, to protect from the weather the tops of walls and the upper surface of large projections, such as cornices, for which purpose sheet lead is employed.

With regard to the execution of the sculpture spoken of, one cannot but be surprized at the number of workmen in Paris, for the most part very young, who are found competent for it. They form a class which we have not, but much want in England, coming between the mere stone cutter and the professed sculptor,—the first of whom cannot execute this description of work, and the latter may not. Our schools of design when made numerous will perhaps supply this desideratum, but that which would perhaps be even more effective in producing the class of artists alluded to, is a greater demand for this description of talent on the part of the public. Did we require here to cover a house with foliage and figures of stone, we should have to make search for half a dozen men capable of performing it satisfactorily, whereas in Paris there are scores, it might almost be said hundreds, judging from appearances, who could be found to execute it effectively. In the article *Carton pierre*, to illustrate the point a little further, it is found that designs sent from England may be modelled in Paris, worked in this material and returned to us, at less cost than the same designs can be executed here in an inferior manner, chiefly because of the scarcity of efficient hands.

Now we must not infer from the above that there is any want of ability, or any natural inferiority on the part of our countrymen, experience proves the contrary triumphantly: it results there can be no doubt from the little attention paid to the arts of design in the education of our operatives, the want of opportunity to study beautiful forms and to raise their standard of taste by the contemplation of works of fine art, as well as from the limited nature of the demand for artistical productions,—this latter being in part a result of the operation of the two former causes amongst other classes of society. I am glad to find Mr. W. Dyce, the excellent superintendent of the Government School of Design, alluded to this subject in his evidence given before the last Select Committee on the Fine Arts. Mr. Dyce said with respect to the effect the decoration of the new Houses of Parliament would have on the arts of design for manufactures, "we want a middle class of artists; we have only at present artists of the highest sort, those who paint pictures, and of the lowest, who make patterns of the worst description for manufactures; we want a middle class, who have the knowledge of artists, and the skill of ornamentists." And again, "I should say the same thing with regard to sculptured ornaments as I have said with regard to painted ornaments, that we want a middle class of artists,—a class of artists who could execute such statues as those in Henry the Seventh's Chapel, which are not good enough to be the work of first-rate sculptors, but still are sufficiently good for the purpose."

To return to the mode of building in Paris, it will be observed by every one that plain squared masses of stone are alone put up in the first case, and that all the ornamental parts are worked out of them after the erection is finished, beginning at the top and making all perfect as they go down. When a very hard stone is not used this method seems to have several advantages: injury to delicate parts during the progress of the work is avoided, and furthermore the effect of a decoration in its position can be judged of when first commenced, and altered if need be.

Many of the doorways in recently finished hotels are exceedingly elegant. In some cases the upper panels contain glass protected by elaborate ironwork of beautiful designs.

M. Hittorff to whom was confided the completion of that *rendezvous* of monuments, the Place de la Concorde, after the erection there of the Luxor obelisk, has constructed a theatre for the exhibition of horsemanship in the Champs Elysées, and called the *Cirque National*, which is perhaps the most striking thing of its kind ever seen. The plan is a polygon with a portico on one side adorned with sculptured figures and enriched mouldings. Colours are successfully employed here in external embellishment of the architectural members, being so far as my own knowledge extends, the only instance of their use on a stone building in France or England.* The building is of large size, and would probably contain several thousand persons. The seats, much elevated one above the other, extend all round the theatre, the arena being in the centre, and the horses and performers entering by two openings on the ground level. When filled with spectators the upper part presenting vast unbroken circles of them, the effect is very striking. The roof, which together with the rest of the interior is a mass of ornamental painting and gilding, is supported on sixteen very light columns (of iron) and arches.

Amongst the most important restorations going on are those of the *Hôtel de Ville*, (designed nearly at the commencement of the 16th century and completed at its close,) and of the *Sainte Chapelle* adjoining the Palais de Justice. At the former, which is a curious and valuable specimen of the *Renaissance* period, the style whereof in its purer shape, is now literally the *rage* in Paris, considerable additions as well as restorations are being made at a great expense. At the *Sainte Chapelle* where every one knows there is some most excellent stained glass, the whole of the interior having been originally painted and gilt, is being restored. In order that it may be made a perfect work, the municipal council have voted the sum of 4,000*l.* annually, to be paid, it is said, so long as the architect may require it for this purpose! The fact that in the interior of nearly all churches in the middle ages, colours and gilding were employed systematically to aid the architectural effect, has been but recently arrived at with certainty either there or in our own country: now however, scarcely a week passes without fresh discoveries in confirmation of its truth. In much earlier times the same aid was resorted to, as is proved by the build-

* M. Hittorff it will be remembered, was the first writer, supported by disjointed remarks on the subject by previous travellers, who boldly asserted that the Greeks systematically adopted polychromatic decoration in their buildings. See his paper "*De l'Architecture Polychrome des Grecs*," also his fine work on Sicily. It required no ordinary degree of nerve to make, at that time, such a statement.

ings of Egypt, Etruria, Greece, Byzantium,[*] and Pompeii. The painted decorations of our own churches were all coloured over or otherwise obliterated at the Reformation, (when sculpture, stained glass, and many monumental brasses were also destroyed,) and the whitewash of the churchwarden has served each year since to render the discovery of them more difficult. The spirit of restoration which now prevails in many quarters, has brought numerous instances to light, as in the Temple church in our own metropolis, to which as its renovation has been commenced, we may soon hope to refer as an example.

At the Cathedral of St. Denis, near Paris, (the stone work of which has been entirely restored,) traces of colour on the various architectural members were found almost universally. The chapels and aisle of the choir are consequently again adorned with colours, gilding and arabesques. The columns are covered with leaves, foliage and shields, the capitals being gilt: the vaultings are blue with silver stars upon them in some parts, and in others trefoils and quatrefoils in red and gold. Wherever it was practicable, it is said, they adopted the original painting as a guide, but this does not seem to have been the case very generally.[†] The large rose window in the north transept has been filled with stained glass from the establishment at Choisy le Roi, and other windows for the cathedral are in progress of execution at the same place. In the south transept one window is nearly completed, and presents a very indifferent design commemorative of a visit to St. Denis by the present king.

For the church of St. Gervais in Paris, where considerable restorations are in progress, two very excellent stained glass windows are in progress at the Choisy works. While speaking of restorations it may be mentioned that the cathedral of Notre Dame is about to undergo a thorough repair and renewal. M. H. Godde is the architect to whom the honourable task is entrusted.

The interior decorations of the *Madeleine* are making progress, but are still far from being complete. The ceiling, which forms three domes, is a mass of gilding, the flowers in the panelling being simply backed with blue colour. The capitals of the columns and the face of the fluted shafts are gilt, as is also the entablature. The sculptured frieze presents some slight colourings successfully introduced. Coloured marbles are profusely employed in the lower part of the church, (as, it may be mentioned, is the case in most of the modern French buildings,) and in the absis:—the pavement is entirely of marble, and the whole of the decorations of the most costly kind. Painting and sculpture in their highest walks are called in to aid the general effect. Several fine statues in marble are already in their places, and others are in preparation. The semicircular portions of wall above the entablature, enclosed by the pendentives of the domes are appointed to receive large paintings, indeed many of them are finished, and most of them commenced. The mode adopted is that termed in France painting *à la cire*, and by us, encaustic painting:—a preparation of wax and certain colourless resins kept in a state of fluidity by volatile oils, are employed as the medium for the colours on heated walls. M. Montabert, author of a work entitled *Traité complet de la Peinture*, was the first writer who made known to the moderns this very ancient mode of painting, and he himself executed many pictures in this way twenty or five and twenty years ago, the whole of which continue, it is said, without the slightest alteration. In France a very strong impression exists in favour of its great superiority over Fresco, and as at this moment (when the manner of decorating the new Houses of Parliament excites so much interest, and is ready of so much importance to the progress of the arts,) it is desirable that we should obtain all the information in our reach on the subject, so that the best mode may be employed, I propose offering hereafter a few detailed remarks on the subject. Besides the Madeleine, Notre Dame de Lorette, St. Denis au Marais, the Château of Fontainebleau, &c., contain specimens of this method of painting.

Mentioning Notre Dame de Lorette, I cannot avoid pointing it out as an extraordinary instance of the application of the decorative arts to church architecture, although it is now perhaps well known to all. Large pictures fill the clerestory and the sides of the chapels, figures, symbols, arabesques, and Latin texts on gold or other grounds, cover every inch of wall, the Ionic columns which support the ceiling are apparently covered with composition or varnish of a cream colour with a high polish, the ceiling of the nave is formed into panels, each containing an ornate flower, and is adorned with colours and gilding,—chocolate, blue, and white, predominating. The choir is terminated with a dome, the whole of which is painted. The cost of this extraordinary building, which occupied fourteen years in completion, and called into requisition the talents of most of the principal artists of Paris, was £82,000,—defrayed by the city of Paris.[*]

Want of time prevents me from dilating further at this moment, on the Column in the Place de la Bastille, the restoration of the sculpture in the portico of the Chamber of Deputies, the decoration of the Pantheon, the establishment of a Society of Architects in Paris,[†] and the competition designs for a monument to Napoleon in the Hotel of the Invalids, afford ample matter for much comment. The last subject, indeed, seems imperatively to demand a few words, as this proposed monument has excited the greatest interest in France during the past twelve months, and can hardly be said to be devoid of it here.

More than eighty *projets* were received, notwithstanding a general feeling against the competition prevailed in the minds of artists on account of the profound silence which was observed by the Minister of the Interior (to whom the designs were directed to be forwarded) as to the names of those to whom the selection would be confided. The designs, immediately after they were received, were exhibited to the public without restriction, in the Ecole des Beaux Arts, and attracted great numbers of persons. They were nicely arranged, none of the drawings were torn or injured in hanging, and all were seen equally well—points to which, in conjunction with the very important step of public exhibition *before* making the decision, committees here in similar cases would do well to attend.

A subterranean chapel formed beneath the dome appears to be the favourite idea. M. Visconti, M. Labrouste, M. Isabelle, M. Battard, and others, have adopted it. In M. Visconti's design the chapel is open at the top (being protected by a balustrade around it on the pavement beneath the dome), and is approached by a subterranean passage of great length opening into the *Cour Royale*, where he proposes to erect an equestrian statue of the Emperor. M. Labrouste's chapel, on the contrary, is covered by an enormous shield of bronze gilt, supported some few feet above the pavement by four white marble eagles, allowing a view of the sarcophagus containing the remains of Napoleon, in the chapel beneath. The shield, which is of elegant design, would be 50 feet in length, and could hardly fail to produce a striking effect.

M. Duc exhibited a very beautiful enclosure of gilt bronze, surmounted by an elaborate canopy, and containing a porphyry sarcophagus. Two figures of white marble sit beyond the enclosure, and the whole is surrounded by a balustrade. M. Feuchere had a model of considerable merit representing an oblong temple of eight columns on a stylobate, which is elongated at the four angles to receive figures. Within the temple is the sarcophagus, and above it a statue of the Emperor.

M. Felix Duban has designed an elegantly simple sarcophagus on a plinth, against the sides of which latter stand figures. M. Victor Lenoir has a very clever design, and the same may be said of those by M. Morey and M. Bouchet. Mr. Goldicutt's design for the Nelson monument has been worked on by several, and was produced in two or three shapes. There was one *projet* for a colossal figure of the Emperor nearly as high as the dome itself, and another (claiming

[*] Some time since M. Didron, the distinguished French antiquary, obtained from the monks at Mount Athos a very curious M.S., relative to painting Byzantine churches. It is written in Greek, consists of about 350 pages, and is divided into three parts: the first treating of the mode of preparing the colours and the ground work for frescos, the second describing the historical and allegorical subjects which may be represented, the attitude, costume, &c., and the third, the particular parts of the building appropriated to different figures. The text is ascribed to the IX. century, but this particular copy is somewhat later. A translation of it has been made, and will shortly be printed.

[†] No person interested in the preservation of specimens of ancient art can go through St. Denis, and in fact through few buildings in Paris, without feeling how much gratitude is due to the memory of M. Alexandre Lenoir, who succeeded in rescuing from destruction during the Revolution, many magnificent monuments of the middle ages, and preserving them until quieter times. His son, M. Albert Lenoir, one of the government architects, and a man of great talent and zeal, is now engaged on a fine work for the "*Comité Historique*," entitled Statistique Monumentale de Paris, which his father's collections will enable him to complete most efficiently.

[*] The following particulars may be interesting to some. When the city of Paris determined on rebuilding the church of Notre Dame de Lorette (the old church being much too small and mean for its position,) ten architects were invited to send plans, namely M.M. Caristie, Godde, Menager, Chatillon, Gauthier, Le Bas, Nepveu, Lecointe, Provost, and Guenepin, all of whom complied, with the exception of M. Godde. The commission appointed to make the selection was composed of the following gentlemen: Count Chabrol de Volvic, president; Viscount Hericart de Thury, Director of "Travaux Publics," Fontaine, Hurtault, Huyot, Thibault, and Percier, architects and members of the Academy, and M. Larribe, Conservator of the objects of art in the city of Paris, who acted as secretary. The design submitted by M. Le Bas was selected, and reported on at the Hotel de Ville, April 23, 1823; the first stone was laid August 25 in the same year, when a medal was struck in commemoration of the occasion, and the consecration of the building took place December 15th, 1836.

[†] The first meeting was held January 25, 1841.

praise for originality, if not for good taste, to hang an enormous eagle of bronze by the tips of its expanded wings from wall to wall, a little below the springing of the dome. Borne up in the talons of the royal bird, the sarcophagus would be suspended, Mahomet-like, 'twixt heaven and earth.

Although the exhibition contained much that was satisfactory, it could hardly be said to be worthy of the architectural and artistical talent existing in Paris. Some of the drawings were exquisitely executed.

ON COLOUR AS APPLIED IN DECORATION.

By Hyde Clarke, F.L.S., &c.

At the present period, when so much interest is excited as to the decoration of our public buildings, and when a better epoch for this department of art seems opening, the subject of the laws which regulate it can scarcely fail to be attractive to the profession, as the theory of colour and its relations to heat and electricity have been already explained in the Journal, (Vol. II, p. 188,) we can at once consider the practical portion of the subject; but I should first wish to call attention to M. Chevreul's theory of contrast, with some few remarks I have to make upon it. M. Chevreul says (De la Loi du Contraste Simultané des Couleurs: par M. E. Chevreul, Membre de l'Institut), that where the eye sees at the same time two contiguous colours, it sees them as dissimilarly as possible, both as to their optical composition, and as to the depth of their tone, so that there may be at the same time simultaneous contrast, properly so called, and contrast of tone. Thus if two colours *a* and *b* are in juxtaposition, they will differ as much as possible from each other when the complement of *a* is added to *b*, or the complement of *b* added to *a*. If we choose for our experiment orange and green, and if we place orange by the side of green. blue, the complement of the orange, is added to the green, which thus becomes more blue and less yellow, and so similarly the red, the complement of green, is rendered more vivid in the orange, which also becomes less yellow. M. Chevreul has not suggested the cause of this remarkable phenomenon, but I am myself inclined to attribute it to a tendency which the colours have to balance each other, in a manner like to that in which heat diffuses itself from a heated body to one of a lower temperature, and similar to the law of electrical distribution. If this should be the case, it would also be confirmatory of a homogeneity of colour, which many other circumstances would lead us to believe, so that light, instead of being considered to be composed of three simple coloured rays, would, according to that view only, owe the phenomena of colour to the different arrangement of its particles, as ponderable substances, according to the arrangement of their molecules, vary their forms. Colour, perhaps, after all, is only dependent on electrical action, and could we establish this, our way would be clear to the production of coloured representations by electricity, instead of the present daguerréotypes, and to many of the operations of dyeing.

Pursuing his remarks M. Chevreul says that it is evident that the phenomena of simultaneous contrast would increase the brightness both of *a* and *b*, and make them appear more brilliant than they would when looked at isolatedly. If the colours brought together belong to the same group of rays, and only differ in intensity, the clearest in tint will appear still clearer at the point of contact, while that deepest in shade will appear deeper, the tints will be regularly affected from the point of junction, the one set lighter and the other deeper. Coloured and white bodies, when put in juxta-position, become, the former more brilliant and deeper, and the latter of the complementary colour of the others. Thus green and white: red, the complement of the green, is added to the white, and the green appears deeper and more brilliant. In the juxta-position of coloured and black bodies, the effect of the contrast of intensity is to deepen the black and lower the tint of the juxtaposed colour; but a very remarkable fact is the weakening of the black itself, when the juxtaposed colour is deep, and of such a kind as to give such a bright complementary colour as orange, yellowish orange, greenish yellow, &c., for instance, with blue and black, orange, the complement of the blue, is added to black, the black becomes lighter, and the blue is clearer, perhaps greenish. All gray bodies contiguous to coloured bodies may present the phenomena of contrast in a manner more sensible than white and dark bodies do. Thus yellow and gray: the gray takes more of a violet cast by receiving the influence of the complement of the yellow, and the yellow appears more brilliant, and yet less iehgems.

Besides this simultaneous contrast of colours, M Chevreul distinguishes a successive contrast of colours, by which he means all those phenomena which are observed when the eye, having for some time looked on one or more coloured objects, perceives, after having ceased to look at them, images of these objects presenting the complementary colour which belongs to each. He also defines a mixed contrast, which is the result of the two others, it takes place when, having looked at a red paper, for instance, and we turn towards a blue, it will appear greenish: if, on the other hand, we look first at the blue, and then at the red, the red will appear orange. These are all well known phenomena, but M. Chevreul makes a practical application of them; he recommends the painter not to keep his eye too long fixed on his model, and the purchaser of coloured goods to be similarly careful, if he wishes to keep his eyes in a normal state to look at the last pattern, otherwise the several patterns will, after the first, appear faded, and less fresh in colour, although they may all be of the same quality. A shopkeeper who shows several silks, say red, should show others of a complementary colour, green in this case, in order to restore the eye to its normal state, and better to prepare it for the red, by making the red look more brilliant than it really is.

I shall now make another halt to give a hint to those of my readers who consult French works as to the use of several words used by the authors: thus *ton* we call intensity, tint and shade, *gammes*, the key colour or tone, and *nuances*, hues. Two or three useful rules I shall also advert to here. The best contrast, it must be remembered, is produced by the complementary colour, and all colours must be of the same intensity.

When two colours do not agree, it is best to separate them by white. Black is also useful for this purpose when applied with bright colours, and, in some cases, preferable to white.

Black may be advantageously applied with sombre colours, and with some of the dark tertiaries.

It will now be necessary to consider the several colours separately, in doing which I shall principally avail myself of Mr. Hay's work on colour,* the best and cheapest practical work on the subject, and one which, to the professional man and to the student, is indispensable.

Like Mr. Hay, I shall begin with white, the representative of light, which is regarded as produced by the reflection of the three primary colours simultaneously in their relative neutralizing proportions. Although there are eight kinds of whites, there is only one which is understood as a pure white. Its contrasting colour is black, being opposite to it in the scale, but the arrangement in which its effect is the most happy is with blue and orange. In the series it lies nearest to yellow, which may be adopted as its melodizing colour. With nearly all colours, however, it harmonizes in conjunction and opposition, and to its properties in separating two discordant colours I have already referred. It does not agree so well as gray with red and orange, and with blue, violet, &c. it is harsh. It is to be preferred to gray with yellow and blue, also with red and green, red and yellow, orange and yellow, orange and green, and yellow and green. With very light primrose, yellow forms an agreeable arrangement. All colours brought in contact with pure white must be light and cool, amongst which gray and green may be employed, and intense or rich colouring must be avoided. A south light is the best for white, which, when it is the predominating colour for a room lighted from the north, should be made of a cream colour, so as to get rid of the cold reflection as far as possible.

French white is, properly speaking, the lightest shade of purple, and is seldom used in house painting, but Mr. Syme says that he has seen it made the prevailing colour of a drawing-room in a country residence with good effect. It can only be introduced when all the other colours are light and cool in tone, as any quantity of intense or rich colouring completely subdues it.

Black, the representative of darkness, is regarded as produced by the absorption of the three primary colours, simultaneously in their relative neutralizing proportions. In the series it lies next to purple, which may be considered as its melodizing colour. Its contrasting colour is white. we may also add yellow, but it is most happy in combination with red and green, red and yellow, orange and yellow, orange and green, and yellow and green. By being associated with sombre colours, such as blue and violet, and with the lower tints of the bright colours, it may be often made to produce a very good effect. It is always happy when used with two bright colours, as orange, yellow, red, and bright green. As a separating colour it is often to be preferred to white. It is not so good as gray in combination with orange and violet, green and blue, and green and violet. It is only in arrangements of a cool and sombre character that it can be used in large quantities, and it is recommended to be used always pure and transparent. The ancients used it happily and in great profusion, and in

* The Laws of Harmonious Colouring. By D. R. Hay. London W. S. Orr, 1838.

the monuments of the Egyptians, the vases of Greece and Italy, and the decorations of Pompeii and Herculaneum. We find it in combination with the brightest colours, often used as a separating colour or as a contrast, and always with effect. Mr. Hay recommends great caution in the use of both white and black, for being at the top and bottom of the scale, they are very dangerous colours to manage. Where gorgaousness is the object, they must not be brought in.

Pure Yellow, of the power of 3, which Mr. Hay calls yellow jasmine, or a deep lemon hue, is the lightest of the three primary colours, and the nearest to white. Its contrasting colour is purple and it forms a strong contrast to black. Its melodizing colours are orange and green, which are the secondaries it forms with red and blue. Its ternary is citron, and its quaternary is brown and marrone. Being the most powerful of the primary colours, it is most offensive to the eye when used extensively in a pure state. With red, orange, or green, it does very well in combination with black, and even with gray. In artificial light yellow, it is well known, appears to be of less intensity, as is the case with all colours into the composition of which it enters.

Primrose, which is a very light yellow, forms a pleasing arrangement with pure white, being a light and cool colour.

Red, of the power of 5, is, by Mr. Hay, represented to be of the most intense geranium colour, and as difficult to be defined: it is the second of the primaries, a very warm colour, and the most positive of all colours, pre-eminent among them. Its contrasting colour is green. The secondaries with which it melodizes are its combinations with yellow, forming orange, and with blue, forming purple. Its tertiary is russet, and its quaternary is marrone and slate. With another bright colour it forms a good arrangement with black, as it does also when combined with yellow. Being a warm colour, it acts upon all colours brought in contact withit, or into which it enters, and must not be used on a large scale uncombined, requiring great skill in its use. It is heightened by artificial light. It is considered to be an excellent key colour, and when so used, it is recommended that its contrasting colour, green, should be neutralized by being brought down in tone towards olive.

The nearest hue of red towards yellow is scarlet, which is very brilliant, and requires much the same management as orange. It must never be used in large masses, except under very peculiar circumstances. Its contrasting colour is a bluish green. The ancients used black with scarlet.

The nearest hue of red towards blue is crimson, one of the most gorgeous, at the same time most cool and mellow, and very useful as a key colour. Its contrasting colour is a citron green, and its melodizing colours a bluish green and reddish purple.

Pink is the next hue after crimson, and is very useful for heightening reds in cool toned arrangements.

Blue, of the power of 8, is the deepest of the primary colours, and the nearest in relation to shade. It is a cool colour, acting upon colours used with it, and may be employed in masses with much less glare than either of the other primaries. Its contrasting colour is orange. The secondaries with which it melodizes, are its combinations with yellow, forming green, and with red, forming purple. With green, however, blue is very discordant, more so than any primary with its secondary. Its tertiary is olive, and its quaternaries slate and marrone. With orange it makes a good arrangement with white, and with green agrees with gray, and with violet it enters into composition with black. Black may be very advantageously used with it under many circumstances. White and blue are apt to appear raw in contrast. When used with green and olive, on account of the discord, blue requires the interposition of gray, or of some other neutral colour, with olive a purply gray may be used. Blue is reckoned a good key colour, where a refreshing appearance is desired: with artificial light, however, it is chilled.

We now come to the secondaries.

Orange is a compound of yellow 3 and red 5, being of the power of 8. It is one of the most brilliant colours there is, and the contrast to blue; it requires therefore to be used with a sparing hand, although it is reckoned a good key colour. Olive also forms a contrast with it. It is the melodizing colour to yellow and red, and is itself melodized by its tertiaries, citron, formed with green, and russet with purple. It is acted upon by artificial light much in the same way as yellow is. With blue it may be combined with white, and with red, yellow or green may be used with white or black. With more yellow the hues orange forms, are gold, giraffe, &c., and it then requires for its contrast purplish blue.

Green is the coolest of the medium of the secondaries, and is composed of yellow 3 and blue 8, being of the power of 11. Its contrasting colour is red, and also russet. Green melodizes with yellow and blue, and is itself melodized by the tertiaries, citron, formed with orange, and olive with purple. It is one of the worst colours under artificial light. With red, orange, or yellow it may be used in composition with black or white, but with blue or violet gray is to be used. Being such a soft colour, green may be used in quantity without fear. It requires great care when used with blue, and should be separated by a neutral tint.

Purple is one of the darkest colours most nearly allied to black; it is of the power of 11, and is composed of yellow 3 and blue 8. Its contrasting colour is yellow, and the tertiary citron, which is much used with it. Purple melodizes red and blue, and is melodized by its tertiaries russet formed with orange, and olive with green. It is a cool colour, and it suffers much under artificial light, but next to green it may be used with the most freedom. With green or orange it may be used, with gray and with blue black is to be used. With white its combinations are very raw.

Indigo is the first hue, formed by blue on its union with red, and is a heavy colour little used, except in wove fabrics.

Purple forms various hues as lilac, &c., with which citron may be advantageously used.

Gray is a neutral colour, and enters with effect into many combinations, being the medium between light and shade. It is very useful in separating blue from green or olive. Its most happy combination is with red and orange, and with orange and violet, green and blue, and green and violet.

To proceed to the tertiary colours.

Citron is a tertiary colour, in whith yellow predominates, it is composed of orange 8, and green 11, being of the power of 19, or yellow 6, red 5, blue 8, its contrasting colour is purple, and also slate: it melodizes with orange and green, and is melodized by the next series, brown formed with russet, and marrone with olive. Citron is greatly relieved and harmonized by olive. It is soft and pleasing to the eye, and is the lightest of the tertiaries, much used as a contrast amongst low hues of crimson and purple.

In russet, red predominates, being composed of orange 8, and purple 13, of the power of 21, or yellow 3, red 10, blue 8. Its contrasting colour is green, and also marrone. It melodizes with orange and purple, and is melodized by the next series, brown, formed with russet, and slate with olive. This tertiary is of great use, and particularly with green.

Olive has blue for its predominant constituent, and is composed of green 11, and purple 13, being of the power of 24, or yellow 3, red 5, blue 16. Its contrasting colour is orange, and also brown. It melodizes with green and purple, and is melodized by marrone formed with citron, and slate formed with russet. Olive has a great relation to shade, and is characterized by Hay as soft and unassuming, being of great use in all arrangement, whether cool or warm, being employed with the lower hues of warm toned or brilliant composition. It must not be brought in contact with blue, but separated by gray.

The next rank is held by the quaternaries or semi-neutral hues. These are:—

Brown composed of citron and russet, of the power of 40, consisting of yellow 9, red 15, blue 16. Its contrasting colour is olive. It is a most useful colour in the low parts of warm toned arrangements.

Marrone is composed of citron and olive, being of the power of 43, or yellow 9, red 10, blue 24. Its contrasting colour is russet. This semi-neutral is most useful in wove fabrics. It is considered to be deep and clear, and although allied to red, may be used where there is a preponderance of cool-toned colours.

Slate is the deepest of the semi-neutrals, and is composed of russet and olive, being of the power of 45, or yellow 6, red 15, blue 24. Its contrasting colour is citron, and it can only be used in cool-toned arrangements.

FIRE-PROOF CONSTRUCTION NECESSARY TO GENUINE ARCHITECTURE.

By Alfred Bartholomew, Esq., F.S.A.

The three recent great fires at the Parliament Houses, the Royal Exchange, and the Tower of London, with those at Hatfield, Lord Dinorben's, and the Marquis of Londonderry's, while they show that public and aristocratic property can, under the present vicious mode of construction, no more escape than private houses, are no doubt calculated to awaken prudence if every other warning should fail.

He who would be a reformer of any abuse must of necessity prepare himself to be accounted first a kind of monster—then if not absolutely insane, certainly not in his proper senses, and mayhap as far from right-mindedness as Don Quixote himself: but he who would conquer must often previously stoop for that end, and should as little attend to the clamor which is made about his ears by the ignorant, the superficial, and the senseless, as the lady of oriental story who went to disenchant her brothers, or Rinaldo of *La Gerusalemme Liberata* in the enchanted wood; if he persevere, some circumstance or other will be sure to turn up, which will show the mad sayings of such a Quixote, are not so mad as they appeared to be.

Perhaps the fire at the Tower may be considered a fortunate circumstance, though it has destroyed many proud trophies of national victory, since it has not only consumed an ugly inappropriate unfortress-like edifice, with a vast store of wretched useless arms which it is confessed were unfit for service, but has so harrowed up public attention to the subject, that it may be doubted whether any more such dangerous repositaries may be built for containing public records, trophies, libraries, pictures, or curiosities.

If our ideas did not "*run*" as Dr. Robison says, "*in a wooden track*," and so induce the designing of buildings upon false principles, perhaps hardly such a thing as a combustible public building would exist. The cupola of the Pantheon, Palladio's representation of the reputed Temple of Vesta at Nismes, the Cathedral of Milan, the Church of Batalha, Rosslyn Chapel, and the Kitchen of Glastonbury Abbey, show buildings may be roofed not only incombustibly, but also without loss of sectional space between a ceiling and an outer covering—a beauty which, though often discoursed upon, is but very rarely produced.

At the present day it is scarcely necessary to notice how much more handsome and architectural, are solid vaultings than flat combustible ceilings: neither in good construction nor fire-proof construction, is it likely that any thing so ugly and unarchitectural as a dome rising out of a flat ceiling could ever be found; nor is it now much more necessary to show that all the generic beauties of pointed architecture, are the direct and necessary emanation of fire-proof construction, every form from the summit of the vaulting of a church to the buttress feet, resulting from that masonic cunning which was put in action throughout the work to make every stone press to its neighbours, instead of suffering any cross strain, and snapping beneath it like modern flat stone lintels and architraves; the only parts which, in pointed architecture, are ever found violating this principle, are the ugly ill-formed combustible roofs with which so many ancient churches are covered, and which frequently being heavy, ill-designed, and badly put together, by counteracting the masonic skill contained in the walls, vaultings, and buttresses of such fabrics, cause nearly all the ruin which such edifices suffer. The finest piece of middle-age carpentry does not contain a tithe of the skill possessed by the freemasons; the imitation of ancient carpentry, in modern architecture is a positive vice: national edifices built without such carpentry would be found, in the long run, cheapest. It is to be hoped that when the London Guildhall shall be rendered safe, by the removal of its present roofing, there will be no new introduction of a roof of wooden faggots for the martyrdom of its marble monuments.

Not only may all edifices be incombustibly vaulted to appear tolerable, but to be in the highest degree architectural, and with the additional beauty of colour: for vaultings may be formed in mosaic of different coloured bricks, in herring-bone, chequered, or in any other manner: and indeed by covering over the centering with plaster of Paris, and drawing upon it any patterns, devices, or figures, every kind of pictorial representation may be made as it were in carpet-stitch, needing no plastering, no extraneous application of colour, scarcely any future repair, and requiring from time to time simply to be washed clean; parts of such vaultings may be glazed, parts may be finished with fine porcelain, and the whole may be heightened with unfading fired gilding. In some cases, patterns may be formed in light and shade by indentations in the bricks, or by sunk stippled-work; in others variety of colour may be produced by sunk indentations filled up by cement, some bricks with one colour, and others with a different one: in palaces and the higher class of edifices, embossed work and all these methods may be united to produce one rich effect. To insure security to such vaultings with the least possible material, and therefore to render them lighter, and consequently requiring less abutment, to make them, if possible, more secure, though of but an inconsiderable thickness, in all cases each brick should be secured to its neighbours by small copper pins or plugs, so that though any trifling settlements should happen to any part of the vaulting, still no derangement should occur, and no part of the vaulting should drop without either breaking the bricks or snapping off the pins. By these means Mr. Bartholomew would undertake to produce a fac-simile of the vaultings of the Temple Church, which neither fire, water, nor air should destroy.

ON THE ECONOMY OF FUEL IN LOCOMOTIVES CONSEQUENT TO EXPANSION AS PRODUCED BY THE COVER OF THE SLIDE VALVE.

Sir—I am very sorry that your correspondent Mr. M. should have found reasons for regretting any expressions of his October letter, and I can assure him that he meets with my most sincere regard, for having found them, so to moderate the tone of his communications, that he places himself in a position in which he is much less likely to meet with asperity. Mr. M. now acknowledges that he objected unjustly to the equation given for finding the area of the piston necessary for any assigned degree of expansion: which acknowledgment is of the more value, since if this equation had been wrong the whole paper would have fallen to the ground: and he also now acknowledges that in consequence of a misprint he was led into the dilemma of supposing that the area of the piston was put equal to the pressure of the steam. Having thus satisfied himself as to the accuracy of the main features of the paper, he now addresses himself to the demonstration that some functions of the question which I neglected as being of very small amount are actually so "appreciable" that even at the expence of very much complicating the analysis he would recommend their introduction. In replying to this demonstration I would have been saved all trouble had Mr. M. subjected all his objections to as rigid a calculation, as he has the effect that the waste space at either end of the cylinder has on the area of the piston, he finds, he says, that the correction which he has introduced for the waste space makes a difference betwixt my formula and his of $\frac{4}{5}$ of one per cent. upon the whole area of the piston: now I have neither investigated whether Mr. M. has correctly introduced into the formula the waste space, nor have I gone through the numerical computation, for if Mr. M. has no objections, I am perfectly willing to take for granted that he is correct in both, and shall seek to produce only his assertion that the correction amounts to so much as $\frac{4}{5}$ of one per cent. on the whole area of the piston, as my defence for neglecting the effect of the waste space.—But although Mr. M. has found the correction to be as stated above, I will at the end of this letter throw out a hint which will enable him to reduce it to much less than even what he has found it, to probably one hundredth part of it.

Mr. M. next proceeds to persuade me that he understands the mode of analysis it is necessary to follow in estimating the work performed by an engine working expansively, but in persuading me to believe this, he persuades himself that I did not understand what he meant, and I must allow that that is not only very possible, but very probable; for although I believe that I thoroughly understood his words, yet unless they happened to express his meaning, I could hardly be expected to reach it: but inasmuch as after explanation it turns out that we both meant exactly the same thing, I shall take it for granted that Mr. M. thoroughly understands the mode of analysis it is necessary to follow in estimating the work performed by an engine working expansively, and proceed to the consideration of more important matters, namely, what Mr. M. states to be the real point at issue, and that is whether the constant term (t) in the expression $\frac{a'p}{x} - t$ faithfully represents the negative part of the effect, or the resistance of the waste steam on the back of the piston. Mr. M. states that I put (t) to express both the lowest pressure of the waste steam in the cylinder and the mean resistance of the waste steam; now I most certainly never intended to make (t) express two distinct quantities, and I have examined the paper to see if I had stated any thing which could furnish grounds for supposing I had done so, but I cannot find that I did; for the satisfaction of Mr. M., however, I shall state in words (although to a mathematician I have always been in the habit of supposing the language of analysis most precise,) that (t) is put to express the mean effect of the waste steam. Mr. M. will perhaps now discover that the expression $\frac{a'p}{x} - t$ does not give too great a value by 3 or 4 lb. per square inch. Mr. M. was probably led to suppose that (t) was put to express the lowest pressure of the waste steam in the cylinder by the way in which it is involved in the equation for finding the area of the piston, but if he reconsiders that equation on the supposition that (t) expresses the mean resistance, he will find the error thereby introduced to be very small, and to be in the opposite direction from that produced by neglecting the waste space at the end of the cylinder.

Mr. M. in the next paragraph asserts that when the time given for expansion is excessively short as it is in locomotives, the reduction of temperature due to expansion is not sensibly affected by the heat of the smoke box, and ought therefore to be taken into account; but for two reasons the effect due to this alteration of temperature vanishes, in the first place Mr. M. will surely not deny that if the part of the steam pipe within the smoke box and the cylinders were filled with water it would speedily be evaporated, which must be in consequence of heat imparted, and it is certainly very evident that at least part of that heat must enter the steam; and Mr. M. will find that although the diminution of temperature due to expansion (alone considered) becomes greater with the expansion, so also does both, the surfaces of the cylinder and steam pipe, and the time for which the steam is exposed to the heat of the smoke box: again in the second place, if Mr. M. had introduced into his laborious calculations, to prove that he was right in objecting to the omission of the effect of the steam during the part of the stroke from the opening of the eduction port to the termination of the stroke, the remainder of the effect of this diminution of temperature due to expansion, he would have found that the one so balanced the other that the correction to be introduced though appreciable, is of analogous import ance with $\frac{1}{3}$ of one per cent.

The remainder of Mr. M.'s last letter is taken up in correcting the values of (a' and b) that I calculated for the four particular cases, which presents a beautiful illustration of a person, in his attempt to have the pleasure of helping another over a ditch, stepping into it himself; when Mr. M. first stated that the equations which give the values of (a' and b) are themselves correct, but that the numerical values which I calculated were incorrect, I thought he meant that I had made some numerical mistake, and therefore did not trouble myself about it, but I now see that he imagines I have made a radical error in applying the formulæ, by making incorrect substitutions for the known quantities. Had the formulæ been made on the hypothesis that Mr. M. thinks they were made on, they would (instead of being as Mr. M. thinks quite correct) have been altogether wrong; Mr. M. seems to think that the radius of the eccentric is a function of the cover of the slide, whereas such I never intended it to be, and such it is not which Mr. M. might have very easily discovered by looking at the investigation of these formulæ. The stroke of the valve being in no degree dependent on the cover of the slide does not at all effect the size of the port for the admission of the steam. Mr. M. will hence find it necessary to recalculate his values of (a and b), and make the alterations thereby caused on his laborious calculations with reference to the omission of the effect due to part of the stroke from the opening of the eduction port to the termination of the stroke.

I will now conclude this letter by remarking that so far as economy of fuel is concerned, so far as the advantage that an engine working expansively has over one working with full pressure is concerned, we may neglect taking into account all things that equally affect both, which I would recommend Mr. M. to consider in estimating the value of some of his objections.

And I remain, Sir,
Your obedient servant,
J. G. Lawrie.

Cartsdyke Foundry, Greenock,
November 15, 1841.

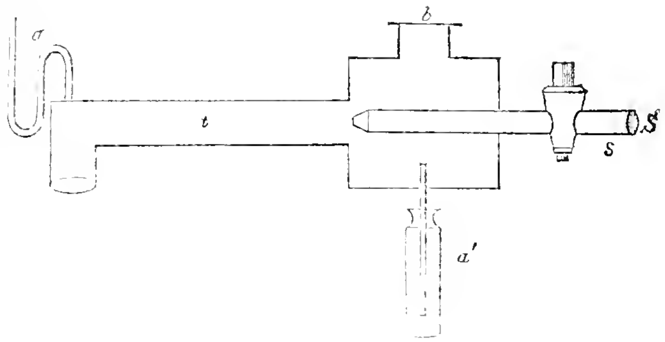
EVAPORATION OF WATER.

Sir—Having obtained a patent for certain improvements in evaporation, I take the liberty of sending you a description thereof, and also an account of the result I have obtained from the apparatus; should you consider this communication of a nature interessing to your numerous readers, I shall be happy to see it inserted in your very useful Journal.

If an open vessel containing water is placed over a fire, the water will take up heat and will retain the same until it boils, after which the water will throw off with the steam exactly the same quantity of heat that it takes up from the fire.

If the steam thus generated under atmospheric pressure is forced into a worm contained in the water, so as to acquire a pressure of about one twelfth of an atmosphere, it will be condensed therein at the rate of about 3 lb. of steam per hour for every superficial foot of refrigerating surface of the worm, and as by condensation all the latent heat of the steam will be given up to the water, a corresponding evaporation thereof will be effected, so that providing there was no loss of heat by radiation or other leakage, a liquid once brought into a state of ebullition might be constantly kept in that state by its own steam alone; loss is however inevitable, so that the liquid can be kept boiling, only with the addition of a sufficient quantity of heat to compensate for the loss by radiation, &c., and with the assistance of the power requisite to compress the steam within the worm, this compression can be effected either by means of a pump, or by a blast of high steam; the action of a pump is too well understood to need any explanation, I will therefore merely describe the mechanical action of a blast of high pressure steam employed as a substitute for a pump.

A blast of high pressure steam rushing through a tube of a greater diameter than that of the blast itself, possesses the two valuable properties of producing a pressure at one end of the tube and a partial vacuum at the other end thereof: when steam of about four atmospheres is employed for the blast, and when the diameter of the tube into which the blast rushes is about five times the diameter of the blast itself, a pressure may be obtained at one end of the tube of about 8 inches of mercury, and there will be found behind the blast a vacuum nearly as powerful,—thus



The above sketch will give a correct idea of the blast apparatus.
s, steam pipe when diameter = 1.
t, tube through which the blast rushes diameter = 5.
a', vacuum gauge.
a, pressure gauge.
With steam of about 4 atmospheres the gauge a will mark about 8 inches of mercury, and the gauge a' something less.

Now if the branch pipe b is connected to the steam chamber of an evaporating pan in which the steam is produced under atmospheric pressure only, the blast of high steam as above described, will absorb from this steam chamber about four times its own volume (when reduced to about one-sixth of an atmosphere), and will compress this mixture of high and low steam within the worm giving to the whole a pressure of about one-sixth of an atmosphere.

By the above application the water in the evaporating pan will be evaporated by the steam produced therefrom, and the whole value of the blast, minus that quantity required to compensate for leakage, will be thrown off with the condensed steam through a valve placed at the extremity of the worm, and may be utilized in a separate vessel to heat the liquid to be evaporated previous to its being admitted to the evaporating pan.

The first experiments were made with a double acting pump which drew the steam from the surface of the liquid as fast as it was generated, and forced it into the worm so as to determine an internal pressure of about one twelfth of an atmosphere, the area of the piston was 76 square inches, and its greatest possible stroke $9\frac{7}{8}$ inches, but as the pump was worked by hand the stroke was very irregular.

The pump made 800 strokes in 35 minutes, each stroke being nearly complete; had each stroke been complete, and supposing that there was no loss by the valves, we should have obtained from the valve at the end of the worm.

$$\frac{9{\cdot}875 \times 2 \times 76 \times 800}{1728} = 700 \text{ cubic feet of steam,}$$

$$\text{or } \frac{700}{1800} = 0{\cdot}39 \text{ cubit feet of water,}$$

$$\text{or } 0{\cdot}39 \times 62{\cdot}5 = 24 \text{ lb. avoirdupois of water.}$$

The quantity of water really discharged from the valve was 20 lb. avoirdupois, which was necessarily the real quantity evaporated from the pan. The fuel consumed did not exceed a quarter of a pound, we consequently evaporated 80 lb. of water with 1 lb. of coal; this experiment was repeated several times with the same result in an evaporating apparatus heated externally by fire, and containing a worm for the action of the steam, the surface of which amounted to 21·5 square feet.

An apparatus of this kind might be applied with great benefit at sea to distill sea water, no machinery or steam boiler being required, the apparatus being worked by hand, one man would obtain about 2·66 imperial gallons of distilled water every hour—the pump could be worked in many different ways.

The pump might be advantageously employed for evaporations in all situations where motive power can be disposed of, or where fuel is expensive.

If you consider this communication worthy of a place in your Journal, I will at an early period send you an account of the experiments made with the blast of high steam as a substitute for the pump.

I remain, Sir,
Your obedient servant,
H. H. Edwards.

Park Village, East, Nov. 20, 1841.

EPISODES OF PLAN.

(Continued from page 346.)

As we have laid down no *plan* at all for our "Episodes,"—which though not so divided, may be considered as so many separate papers on the same general subject, and may therefore be treated desultorily, without regard to strict connection with each other,—we shall now allow ourselves to deviate a little from our course by bringing forward an entire plan, as exemplifying a combination of episodical parts, all studied for effect, into one uniform design.

Hardly need we say that the plan is that of a villa, or detached residence, nor is it by any means upon an extensive scale,—far less so, indeed than many that are to be met with in publications containing subjects of the same class. And if, unlike them, we confine ourselves to the plan alone, without attempting to show any thing further, it is so far an advantage that it compels us to dwell upon circumstances which are almost invariably passed over without comment or remark of any kind, in the publications just alluded to, as if the plan was matter of comparatively little consequence, and provided it be free from any very obvious defects and inconveniences—which, however, is not always the case—study as to effect, variety, contrast may be dispensed with, because, however poorly the architect may have performed his part, the upholsterer will make amends when he comes to perform his. The architect or designer himself is an unquestionable person, for it is not to be expected of him that he should anticipate answers relative to all the *Whys* and *Wherefores* that his plan may suggest to other persons; or should explain the motives which have determined its arrangement.

In most cases indeed, there is very little, if any thing, to describe or explain, to note or remark upon, nothing more being attempted than to divide the plan into a certain number of rooms, without any study as to variety or effect. Scarcely ever is a new idea brought froward: on the contrary a good one seems sometimes to have been stopped short of, merely owing to the most obvious one being caught hold of at once, without further consideration being given to the subject. Yet even such crude and common-place plans are not altogether without their use—that is, to those who have capacity enough to make such use of them—because they serve to show the defects that ought to be avoided, and to make evident the deficiencies that ought to be guarded against. It is very true a house may—it considered merely with regard to its principal object as a dwelling—be an exceedingly good and excellent one, even though it should be utterly deficient in any beauties of plan: yet such also it may be though it should possess no other beauty of any kind to recommend it. And if it be worth while to study elegance of exterior form and appearance, it is surely equally so to study beauty of plan,—not mere internal decoration alone, but also piquant variety in the forms of the several apartments, and in their distribution. Nevertheless, the reverse is the usual practice, for far more attention is bestowed on embellishment, whether as to furniture or any thing else, than on the other sort of effect, notwithstanding that this last must be provided for in the plan itself, whereas deficient decoration can be supplied at anytime.

Should it be said that all this is so obvious as to appear almost impertinent, we ask why, if such be the case, architects should show themselves so negligent of the effects to be obtained from plans, and why they do not urge upon their employers the paramount importance of securing them, even should the additional cost that may be so incurred, occasion some matters of decoration to be postponed at the time the building is erected? These observations may, perhaps, be very injudicious on our part, inasmuch as the plan we here bring forward, may be thought to fall far short of the standard we ourselves set up. Most assuredly it is not for us to say that it affords a satisfactory illustration of our own doctrine, that being a point we must leave others to decide upon when we shall have explained, as we now proceed to do, what we have more particularly aimed at.

Hardly can it be objected either that the plan is deficient in compactness, or that economy has been disregarded, for the front is no more than 58 feet, and returns 27 feet at the ends; which would accord with it in their elevations, while the rest of the exterior might be left plain or nearly so, the plan being there contracted, so that the rear portion of the house would not interfere with the principal architectural mass, more especially were any sort of terrace wall or screen, although only five or six feet high, to be erected for a short distance on the lines *t t*, the ground behind them being on a somewhat lower level, so that the windows of the offices in the basement would there be just above it.

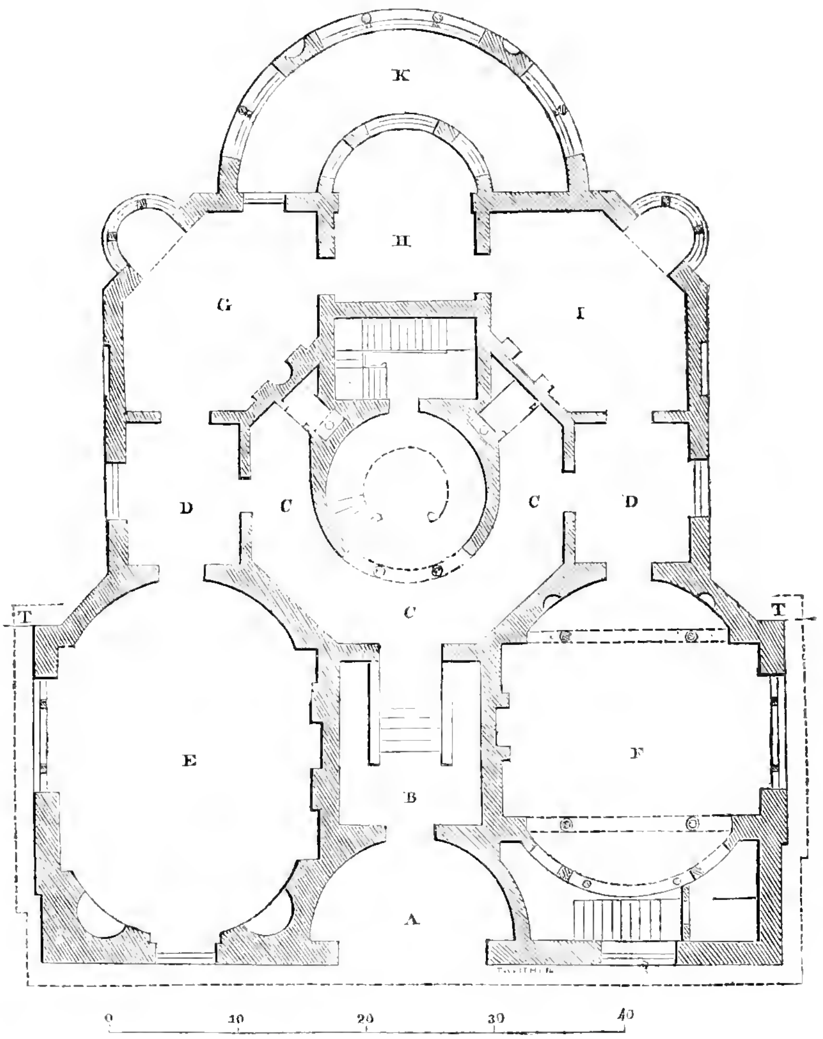
The style of the front is supposed to be Italian, and that part of the exterior to have a cornicione (indicated on the plan by the dotted lines) which would of itself tend to mark out that portion as a distinct composition there intended to terminate, its end elevations obviously belonging to the front, and being independent of the rest of the sides beyond them, where an intentional transition from decoration to plainness takes place, the latter not at all interferring in this case with regularity or consistency. Besides that much more than a single architectural elevation is thus obtained, without continuing its return, for the entire extent of the building, it is perhaps rather an advantage than the contrary, that the general outline is broken, and that formal box-like shape avoided, which generally gives such a disagreeable naked appearance to a detached square house without wings or other accompaniments.

Although the rest of the exterior is distinct from the principal composition it will be seen that that regularity is kept up in it, the rear or conservatory front (here supposed to face the west or south-west) presenting a uniform elevation that might either be plain or decorated, according as circumstances should dictate.

The principal or entrance front is exceedingly simple in composition—though capable of being ornate in character,—it being *astylar* and without breaks of any kind, and presenting only three openings in width, the centre one of which forms a lofty arch to the niche-like loggia or porch, which latter would afford a convenient shelter for servants in attendance upon carriages.

From the loggia *a* we first enter a vestibule *b*, small in itself, but presenting a striking effect in consequence of the staircase being seen beyond it (on a somewhat higher level) through the columns enclosing it, and forming that space into a perfect rotunda, covered by a dome, through which the light streams down from above, and relieves the columns. It may, perhaps, be asked if a good deal is not lost by thus inclosing the staircase,—whether it would not be better to make what is now the staircase and corridor a single octagonal hall, either putting the staircase in it, or giving up some other part of the plan to the latter. That certainly might be done, but besides that it would materially alter the present arrangement for the worse in many respects, such a hall would be too ambitious a feature in a house of this size, and while it would take off from the importance of the two principal rooms, would cause the others to look quite diminutive: whereas now there is with apparently less pretension, greater novelty of character, and sufficient degree of effect, yet not so much as to interfere with that of the chief apartments. There is likewise what we consider to be an agreeable and desirable sort of intricacy attending the arrangement here adopted, there being concealment as well as display. It is impossible for a stranger to understand from what he sees on first entering, the situation, or number of the rooms, or how they communicate with each other. They are approached in such manner as to appear at a considerable distance, consequently the house seems more extensive than it is,—certainly very much more so than would be the case, were the rooms E and F to open immediately into the vestibule *b*,—to say nothing of the much greater privacy and comfort secured by the arrangement here adopted. The privacy of the sitting rooms is further increased by none of them being made to communicate immediately with the corridor, they being entered through *d d*, two lobbies or small outer rooms—for their size hardly entitles them to be called anterooms. Their smallness, however, would not prevent tasteful architectural character being bestowed upon them,—the less so as there would be scarcely any occasion for the usual articles of furniture in them, but merely ornamental ones; on the other hand, it would by contrast serve to give an air of spaciousness to the two larger rooms, and even to render the others of good size in comparison with them.

The drawing-room, E, is the largest of all, the dining-room, F, being made somewhat less in its plan than the other, in order to obtain a staircase for serving up dinner, which must else be brought through the back staircase, corridor, and lobby. What, therefore, is lost as to size is amply made up by increased convenience, and also by variety, because, instead of being merely a duplicate of the drawing-room in its plan, it assumes a very different character; and although columns are introduced in order to define the two alcoves more markedly, there is still a clear central space of 20 by 14 feet, which is quite



sufficient for the accommodation of a comfortable dinner party. The sideboard alcove is divided from the staircase behind it by a partition carried up about seven feet from the floor, or half the height of the room, forming a screen, surmounted either by dwarf columns or caryatides. Behind this screen there is also a retiring closet for gentlemen, lighted by a small window towards the staircase, and provided with proper sinks and water-pipes.

We now come to consider the remaining rooms, which are so arranged that until shown into them a stranger might not perhaps suspect there was any thing of the kind, but suppose the rear part of the house to consist merely of secondary rooms for domestic purposes. Should he therefore happen to be quite unprepared for other sitting-rooms, all the more agreeable is likely to be his surprise on discovering that the doors on the other side of the lobbies open into rooms unusual, and at first sight perhaps apparently rather irregular in plan, but afterwards perceived to be perfectly symmetrical; besides which a change of view in a different direction from that from any of the other sides of the house is here obtained. On entering H, another form of room presents itself, not only different from any of the rest, but in a manner combined with the conservatory, into which it projects. Therefore, although too small in itself to be considered exactly as a distinct sitting-room, this would be a very agreeable little summer boudoir, with its windows thrown open to the conservatory. Between this and the adjoining room I (corresponding in its plan with G), there might be double doors kept locked, supposing I to be appropriated as the master's morning or private room, as in that case it might be more desirable to keep that as much apart as possible from the rest, but still in such manner that it might be made to communicate with them, whenever there should be occasion for throwing open the whole of the rooms to company, so that they may all be passed through from the drawing-room to the dining-room. For the reason above assigned there is no window into the conservatory from this room I, as there is in G.

Having thus far given a specimen of the sort of explanatory commentary which, we think, ought to be attached to all published plans, we will not prolong our remarks at present, but leaving our readers to supply as much more in the shape of criticism upon ourselves—either favourable or unfavourable, as they may think proper, we merely add a list of

References to the Plan.

A	Porch.
B	Vestibule, 13ft. 6 × 11ft. 3.
C C C	Corridor.
D D	Lobbies, 11 × 9.
E	Drawing-room, 30 × 20.
F	Dining-room, 25 × 20.
G	Breakfast or Morning-room, diagonal length 22, width 13ft. 2.
H	Boudoir, 13 × 11.
I	Library or Private Room, as G.
K	Conservatory, 26 ft. diam., 8 ft. wide.

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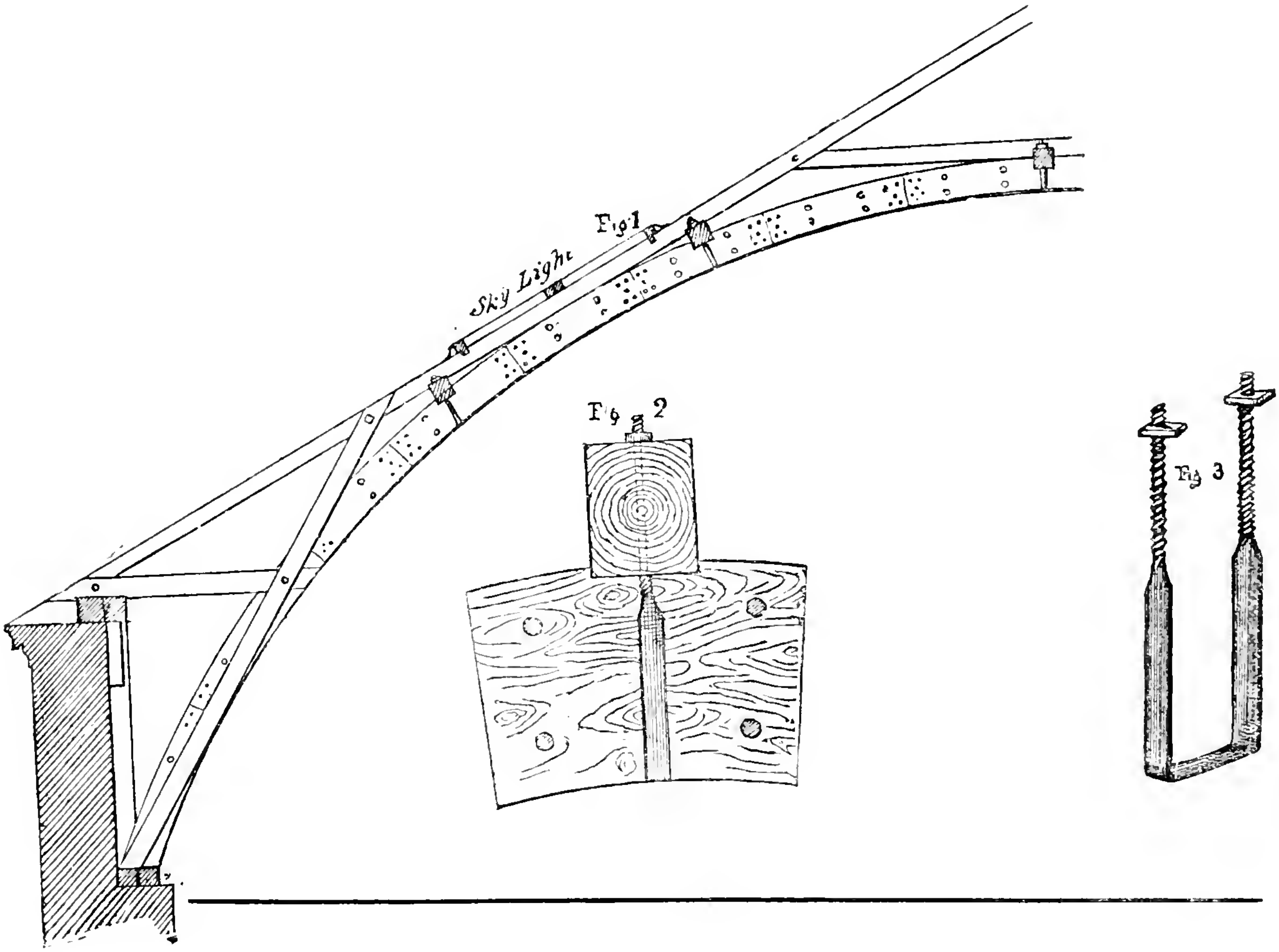


ON CONSTRUCTION.

It is our intention to give occasionally some examples of construction which will be found useful to the student. The annexed engravings show the construction of the Roof over the Polytechnic Institution at Vienna; unfortunately the work (the *Allgemeine Bauzeitung*), from which we take the drawing, contains but a meagre description of its construction, without any reference to the scantling of the timbers; we can therefore only form our opinion of what they ought to be from the geometrical view before us. It is stated that the roof stands remarkably firm; the span is 56 feet, and the rise of the arch 18 ft. 6 in. above the chord bar; the curvilinear ribs or principals are placed 12 feet apart, and are 12 inches in depth, of pieces of timber in 4 feet lengths which are laid side by side in thicknesses so as to break joints; we should apportion three thicknesses of two inches each; upon their ribs are laid the purlins 6 by 5 inches, which carry the rafters 4 inches deep by 2½ inches placed 3 feet apart; upon the rafters is laid the copper covering. The roof is very much stiffened by the braces 6 by 3 inches on each side of the ribs, and horizontal ties of the same scantling bolted to the ribs and feet of rafters; and also caulked down to the pole plates, there are two plates 6 inches square, one lies on the wall, and the other is supported by vertical posts under each rafter; there are also two wall plates each 5 by 5 inches, the wall plates and the foot of the curved ribs ought to be well secured to a cross tie either of timber about 12 by 4 inches, or a wrought iron tie 1¼ inch diameter. The tie beam would also answer the purpose of girders to carry the floor—if it be desired to continue the curvilinear form throughout the roof, horizontal ceiling joists 4 by 2 and 12 inches apart might be notched and nailed on to the front edge of the ribs, the laths could then be easily bent to the form of the curve and plastered in the usual way; to give the room a pleasing effect, it may be lighted by means of sky-lights in the upper part of the roof, and the centre of the curved ceiling formed into circular sashes and glazed with ground, stained or embossed glass.

Fig. 1 is a section of one half of the span of the roof drawn to a scale of a quarter of an inch to the foot.

Fig. 2 is an enlarged view of the purlin secured to the ribs by the iron straps Fig. 3.

A NEW SAFETY VALVE,

Sir—It appears to me that the *corner* in your Journal which was last month occupied by "Funnel," has been filled up but in an indifferent way; I really can see no object in attempting to arrive at a simple end by means of a very circuitous route; what possible advantage can the complicated arrangement of compensating bars, cylinders and radiating arms have over the beautiful, and I may say perfect invention already in use? Mr. Funnel should have fixed a cog-wheel at the end of each arm, and a cam to each leg by way of giving his safety-valve a truly eccentric character, and on such he might have grounded its merits, as it is one feels greatly at a loss to ascertain the object of this *funny* discovery: however, as I hope to spared being levelled to a Candidus, so must I eschew the ways of that worthy, and by setting all banter apart, must merely venture to suggest that Mr. Funnel would do well to enter into such an explanation of his valve as would tend to establish its superiority, or else by screwing it down to oblivion, would acknowledge tacitly or otherwise, that after all his invention is nothing more than what our mutual friend of the Fasciculi might call "a mare's nest."

Believe me, Sir, to be, with respect,

Plug.

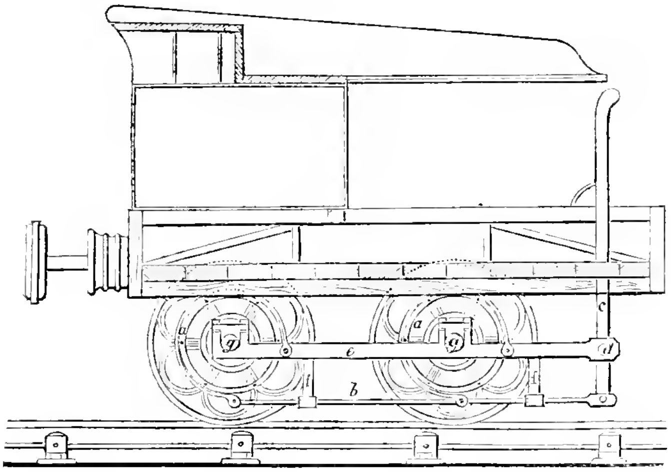
November 22, 1841.

RAILWAY FRICTION BAND BREAK.

Sir—The want of a better system of breaks for stopping or retarding railway trains, has suggested to my mind a plan which I believe to be new, and calculated to remove some of the defects existing in all those now in use; should you think the accompanying sketch and description worthy a corner in your useful Journal, I think much good would be done by directing the attention of mechanics to the subject. I need scarcely say that in the arrangements of the levers in the diagram, the object in view has been to show the principle clearly, rather than to show the best application.

I am, Sir,
Your obedient servant,
George Spencer,
Mechanical Draughtsman.

5, *Hungerford Street, Strand,*
November, 19, 1841.



In the construction of all the railway breaks in use, there appears to me to be two radical errors; 1st. The breaks are applied to only a small part of the wheel, and consequently its power is unnecessarily limited.

2nd. The bearings of the break axles being on the carriages, and the springs intervening between them and the wheel to be acted on, the pressure or friction is never uniform, and the breaksman therefore finds a difficulty in judging the amount of pressure necessary to stop the train.

Now I think these objections may be obviated, by applying the friction band so commonly used in cranes; on this plan the momentum of the train might be *received in any quantity* the breaksman might judge proper.

I think having the break axle bearings on the wheel axles, even with the present breaks would be a great improvement for the same reason.

The diagram will be readily understood by reading the references in the order of the letters.

REFERENCE.

a a, friction wheel and band; *b*, tightening bar; *c*, lever; *d*, lever fulcrum; *e*, bearing bar on axle shaft *g*; *f f*, supporting guides.

ON THE POWER OF STEAM ENGINES.

Sir—I am glad to find in your November number one modest advocate for the introduction of the Wave principle, yet when a failure does take place, as was the case with the Flambeau, we must be frank and admit it, and not clothe it with difference of opinion in calculating the horses power of steam engines.

If Y. takes the trouble to examine the calculation in my previous communication, he will find the mean pressure on the piston 14 lb. not 7, 7·1 or 7·3 as he would have it, without any reference to the pressure on the boiler. I should like to know if 7, 7·1 or 7·3 would hold good in the Cornish engines.

Again, I would ask if an engine made 27 strokes of 5 feet would that amount to 220 feet of piston? I think not; 270 feet will be about it, and Y. will find I only grant greatest speed on the Cyde at this rate.

Again, I have no objections to Y. using 33,000 for his divisor' deducting 25 per cent. on 44,000 I think he will find little difference.

Again, "the least steam assertion is granted, by the account of the change of the boiler." I would ask again, would the Cornish boilers supply steam the whole length of stroke? "but the effect of a new and probably heavier boiler is curious, and an accurate statement of the facts would be valuable." Y. might have omitted "probably'' altogether, every one knows if more steam is wanted, more heating surface must be given, consequently the boiler must be heavier, and the effect of course greater draught of water, and I think Mr. Scott Russell must have known this before he made the proposal. I think Y. will find from this enough to convince him that the assertions made in page 312 is not "based in any degree on the unsound foundation of the difference stated."

I remain, Sir,
Your obedient servant,
H

November 12, 1841.

REVIEWS.

Heath's Picturesque Annual for 1842. Paris in 1841: by Mrs. Gore.

Although some of them are not particularly fresh—rather the reverse—the architectural subjects contained in this new volume, are ably treated in themselves, being from the pencil of Allom, one of the first architectural draughtsmen of the day. It will, perhaps, be thought that Paris itself is now rather an exhausted subject, and that there is very little to be found but what has in some shape or other been exhibited to the public. This, however, is so far from being the case that we could mention several buildings, which we expected to find here illustrated for the first time, but which seem to have quite escaped the artist, notwithstanding that they are of considerable importance. Surely the Hotel de Ville, the Ecole des Beaux Arts, with its screen from Chateau Gaillon, the Hotel du Quai d'Orsay, Notre Dame de Lorette, and several structures—some of them still in progress, others recently completed, would have furnished more than the same number of subjects for the pencil. It is not without cause therefore that we feel disappointed at here meeting with many "old acquaintances," and hardly in a new dress, for the buildings are shown from nearly the very same point of view as we have before seen them represented in Pugin's Paris and other works. This might have been avoided, and we regret it the more because Mr. Allom's pencil would have been more worthily employed on edifices which are as yet little known, in comparison with some of those he has selected. We should have thought that he would have confined himself to entirely new subjects, yet as he did not, we are rather surprised he did not give us an interior of the "Pantheon," by way of companion to that of La Madeleine, in order to afford a comparison between them, as delineated and engraved by the same artists. Beautiful as they are, their merits are of very different kinds, and we are almost inclined to declare in favour of La Madeleine, if only on account of being more novel in character. Its plan is exceedingly simple, forming merely a nave or single vaulted hall, without transept or even aisles, but divided into three compartments, each of which is covered by pendentives and a segmental dome. There is besides a spacious semicircular tribune or apsis at the north end, raised a few feet above the rest of the floor, and covered by a semidome. In one respect this interior is distinguished from almost every other of its kind, namely, in being lighted entirely from above, through the centre of each dome; yet though there are only four apertures of the kind, including that over the tribune, the church is found to be sufficiently well lighted, while the effect is incomparably superior to that produced by side windows; for great breadth and repose is thus given to the architecture, whereas the other mode occasions a confused spottiness. Greatly do we wish therefore that some of our own architects would venture upon the innovation of lighting a church from its roof alone, and getting rid of side windows altogether, more especially as so far from being ornamental they are made invariably the reverse, with exceedingly mean-looking small panes of very ordinary glass, and when ground glass is used the effect is precisely that of a dense fog.

As Mrs. Gore does not trouble her readers with such dry matters as the dimensions of buildings, or in fact with any thing amounting to description of them, we may as well inform ours that those of the interior of La Madeleine are 260 feet in length by 52 in breadth. The exterior view of the same building, is by no means so interesting as the other,—in fact it might very well have been dispensed with, it being no more than a Corinthian peripteral temple, and having also been shown some time ago, in one or two of our weekly publications. We rather wonder that we do not here meet with the *Colonne de Juillet*,—not that it is a particularly good subject in itself, but because it is the newest thing of its kind in the French capital. However, although their subjects might have been more judiciously chosen, the *plates* are by far the best part of the feast—vastly better than the insipid hotchpotch which Mrs. Gore has *dished-up* on her part.

Sporting Architecture. By George Tattersall. London: Ackermann, 1841.

The Edinburgh Review has lately devoted a long article to sporting literature, and the Athenæum has made itself merry with a sporting novel. After such an advent, we were prepared for any miracle, particularly when we remembered what important influence sporting legislation has for centuries had upon the social system fabric; but in what unlooked-for form the genius of sporting was next to be found we could not say, whether lecturing upon sporting æsthetics in our older universities, places long haunted by the Newmarket Minerva, or whether in the Useful Knowledge Halls of the Gower Street College, it was not for us to divine. Imagine, then, our surprise, when we find the new offspring of this union of Diana and Apollo laid at the doors of our own Foundling Hospital, to wit, in the shape of young Tattersall on Sporting Architecture. Sporting Architecture! and why not? when horses are better cared for than men, when the hygeiene of puppies is far more studied than that of the starving thousands, why should not sporting have its architecture as well as its painting and its prose? The numerous occasions on which it is necessary for the builder to make provision for animal economy would alone induce us to give our attention to the subject; but when we have, in the hereditary tastes of Mr. Tattersall, and in his professional skill as an architect, such weighty motives for listening to his themes, we should be, indeed, inexcusable had we the adder's deafness. We can, however, scarcely forbear from a smile when we think of the Choragic Monument of Lysicrates turned into a distance post, and the Erechtheum on the top of a grand stand. With all these incongruities, we must look upon sporting architecture, or architecture for horses and hounds as a subject of considerable importance. In connection with military buildings the proper mode of constructing stables, must be carefully studied, and when we are informed that a sum of 10,000*l.* has in more than one instance been laid out on a dog kennel, 70,000*l.* on stables at Windsor, and that no expense is spared that can preserve the health of the stock, it behoves the architect to look about him. In its bearings, too, upon farm architecture, and the building of railway stations, riding houses, cattle markets, and slaughter houses, the work before us is of interest, and in fact, whether in the stable attached to a private dwelling house, or whether in buildings specially appropriated to the horse, every professional man will find his advantage in adopting Mr. Tattersall's volume as a work of reference. When we look into it we are pleased to see the care the author has taken in availing himself of information from the best sources, and we are pleased with the attention he has devoted to ventilation, drainage, soil and materials. Mr. Tattersall is a man of taste, also; we find his work well and usefully illustrated, so that we look upon it as a good addition to our professional library. Utility is Mr. Tattersall's motto, and in a subject which is generally treated *ad captandum*, it does him great credit that he should have so steadily fulfilled his promise.

Companion to the Almanac for 1842. Knight and Co.

The architectural portion of this new volume of the "Companion," which has just made its appearance so late in the month as barely to allow us to mention it—contains much interesting matter, both descriptive and critical. Among the buildings which are more fully noticed, are, the Houses of Parliament,—Royal Exchange,—the structure in Threadneedle Street,—St. George's Hall and Assize Courts, Liverpool (with plan and perspective view),—Collegiate Institution, do., (with view),—Surry Pauper Lunatic Asylum,—Savings Bank, Bath (with view),—Streatham Church (with elevation),—St. Mary's Southwark (with view),—Trinity Chapel, Poplar (with elevation and section),—and St. Chad's, Birmingham.

A Hand Book for Plain and Ornamental Mapping.—Part II. By Benjamin P. Wilme, C.E. and Surveyor. London: Weale, 1841.

Mr. Wilme's book is a collection of designs for executing the several parts of a map, including ornamental titles, sections, hills, embankments, drains, &c., and may be advantageously used by the engineering draughtsman.

ON EARTH WORK.

By Ellwood Morris (United States), Civil Engineer.

[The following extracts from the American Franklin Journal, show that our transatlantic brethren are alive to the economical working of earth work. We shall be glad to receive from some of our engineers their observations on the increase or decrease of earth work and rock when removed from cutting to embankment.—Editor.]

On the Cost of Excavating Earth by means of Scrapers or Scoops.

Of all machines known to American Engineers, and used upon our public works for the excavation of earth, and its removal to short distances, the scraper, or scoop, is, within its proper sphere of influence, by far the most economical.

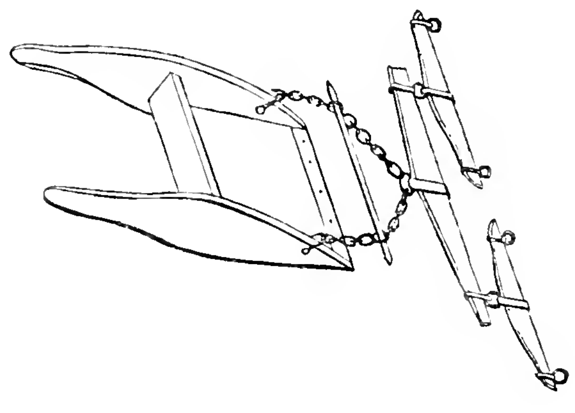
This instrument is particularly well known to canal contractors, much used by them in earth cuttings, and most frequently employed in excavating the trunks of canals, where they are so laid out that the cutting makes the bank, or nearly so; but the *scoop* may be used with success in all excavations of earth where the slopes do not exceed $1\frac{1}{2}$ to 1, if the material to be taken out yields readily to the plough, and is not required to be moved horizontally more than 100 feet, nor to vertical heights exceeding 15 feet; there are doubtless instances where both these limits may be surpassed, and the use of the *scoop* still be highly economical, but such cases are not general, and the practical scope of the utility of *scoops* may be regarded as confined to the excavation of canal trunks, and the formation of low road embankments from side trenches, for both of which purposes it is more admirably adapted.

This machine is drawn by two horses, managed by a boy, and usually requires the ground to be first ploughed; then by simply elevating and guiding the handles a little, the driver causes it to load itself, for the horses being in motion it turns in its clevisses, and inclining downward, runs under the loose dirt like a plough; the handles being released, the loaded *scoop* moves upon two iron shods runners which form the sides, and project below the bottom, and finally after reaching the place of deposit, the handles being smartly elevated, the edge of the *scoop*, which is armed with iron, takes hold of the bank, and the horses moving on, it overturns and discharges its load; in this overturned position, with the handles resting on the double tree, it returns upside down to the place of excavation, and is there loaded, &c., as before.

Although for successful scooping the ground usually requires loosening, and must not be so hard as to resist the plough; it is often the case, especially in sandy material, that it is to soft that the scoop, by its armed edge, is able to excavate it, and load itself, without any previous loosening of the earth.

All this will be rendered so evident to the reader, by an inspection of the annexed isometrical sketch, showing *a scoop*, with its double tree, and single trees, that any further description of the mode of operation seems to be entirely unnecessary.

The writer pursuing his object of acquiring, from actual experiment, a knowledge of the cost of excavating materials and forming embankments upon public works, early addressed himself to observe the effect produced by scoops, and the results of numerous observations upon scooping earth to horizontal distances of from 30 to 80 feet, and heights of 5 to 15 feet, where the slopes are 2 feet base to 1 foot rise, established in a satisfactory manner the following data:



1. That taking average earth (yielding readily to the plough,) at mean stages of weather and seasons, *a scoop load* may be taken at *one tenth of a cubic yard measured in excavation.*

2. That the time lost in loading, unloading, and all other ways per load (except in turning,) is, at an average, *two-thirds of a minute.*

3. That in every complete turn, or semicircle, described by the horses, *one-third of a minute is lost.*

4. That if the mean horizontal distance of transportation of the earth in a right line, *be added to* the extreme height scooped, measuring vertically from the bottom of the excavation to the top of the bank, then for every 70 feet of this aggregate distance, *one minute* will be consumed by the horses in going out and returning back.

5. That if the earth be all scooped to *one side*, as for instance, to the tow-path bank alone, of a canal, *two turns, or a complete circle*, will be made by the horses, for every load deposited in bank.

6. That if the earth be scooped to *both sides* of a canal, but *one turn, or a semicircle only*, will be described by the horses, for each load put in bank.

From the 5th and 6th observations, it follows that clear of the time needed to overcome the horizontal haul and vertical height, the constant amount of time lost per load, will be:—*In Double Scooping*, 1 minute, and *in Side Scooping*, $1\frac{1}{3}$ minute. Now if the sum of the mean horizontal haul, and the extreme height scooped, both in feet, be put $= a$; the number of hours wrought per day, $= b$; the number of cubic yards excavated and placed in bank, per day, by each scoop, $= x$. Then the general formula to find x in *double scooping* will be:

$$\frac{\left(\dfrac{60}{\frac{a}{70}+1}\right)b}{10} = x.$$

Transforming this equation by the rules of algebraic fractions, and substituting for b the average number of hours commonly wrought per day, $= 10$, we are able to reduce the formula to the following;

In Double Scooping, $\dfrac{4200}{a+70} = x$ . . . . I.

And for *side scooping* the general formula will be:

$$\frac{\left(\dfrac{60}{\frac{a}{70}+1\frac{1}{3}}\right)b}{10} = x.$$

Transforming which, by the rules of algebraic fractions, we have:

In Side Scooping, $\dfrac{4200}{a+93\frac{1}{3}} = x$ . . . . . . II.

Now putting *the cost per cubic yard of excavation put in bank clear of all profit*, $= y$; the daily wages of a scoop and driver, in cents, $= c$; the cost per cubic yard, in cents, of loosening the earth, $= d$; the formula to find y, the cost in pence* per yard, either in double or single scooping, will be:

$$\frac{c}{x} + d = y \quad . \quad . \quad . \quad \text{III.}$$

The actual number of cubic yards excavated and put in bank by *scoops*, in several instances, having become accurately known to the writer, the correctness of the formulæ I. and II. will be tested by those cases.

Example I. Double Scooping.

In this case, 3600 cubic yards of earth were excavated and put in bank by 90 days work of *scoops*, or per scoop, per day, 40 cubic yards, x: the mean horizontal haul was $26\frac{1}{2}$ feet; and the extreme height scooped, 8 feet; making the aggregate distance $34\frac{1}{2}$ feet. Then by the formula (I.) we have $\dfrac{4200}{34\frac{1}{2}+70} = 40{\cdot}2$ cubic yards $= x$.

Here the calculated and actual day's work of the scoops is the same within $\frac{1}{5}$ of a cubic yard.

Example II. Single or Side Scooping.

In this case, 5000 cubic yards of earth were excavated and deposited in bank by 176 days work of scoops, or per scoop per day, $28\frac{2}{5}$ cubic yards, $= x$; the mean horizontal haul was 44 feet, and the extreme height scooped, 11 feet; making the aggregate distance, 55 feet, $= a$.

Then by the formula (II.) we have $\dfrac{4200}{55+93\frac{1}{3}} = 28{\cdot}3$ cubic yards $= x$.

Here the difference between the real and calculated days work of a scoop is $\frac{1}{5}$ of a yard.

Conceiving it to be unnecessary to display at length any more of the examples, we will embody, in the following table, the results of actual experiments, and compare them with those calculated by the formulæ.

No. of Experiments.	1	2	3	4	5
Kind of scooping.	Double	Double	Side.	Side.	Side.
Mean horizontal haul	26·5	26·5	44	36	40
Extreme height scooped.	8	8	11	6	9
Value of a	34·5	34·5	55	42	49
Number of cubic yards excavated and put in bank	5000	3600	5000	5610	852
Days work of scoops employed . .	126	90	176	181	28·5
No. of cubic yards actually excavated per day by each scoop . .	39·7	40	28·5	31	30
No. of cubic yards excavated per day per scoop; calculated by formula I. and II.	40·2	40·2	28·3	31	29·5
Cost per cubic yard of the excavation calculated by formula III.	$4\frac{1}{4}d.$	$4\frac{1}{4}d.$	$5\frac{3}{4}d.$	$5\frac{1}{4}d.$	$5\frac{1}{2}d.$

In calculating column 10 of the above table, the hire per day of a *scoop and driver*, has been assumed to be 12*s.* $5\frac{1}{2}$*d.*, and the cost of loosening, at 1 cent (·54*d.*) per cubic yard.

The near coincidence of the results in columns 8 and 9, shows how closely the calculated number of cubic yards, excavated per day, in each of the kinds of scooping, agrees with the real day's work *of each scoop*, as actually ascertained in excavating 20,052 cubic yards of earth; consequently we may regard the formulæ which we have deduced, *as being sufficiently confirmed to justify a full reliance upon them in practice.*

* We have adopted the English pence for calculation, instead of the dollar and cents, as given in the original paper by the author, allowing 54 pence for the dollar.—Editor.

ON THE COMPRESSION OF EARTH, AND THE INCREASE OF ROCK IN EMBANKMENT, COMPARED WITH THE VOLUME IN EXCAVATION.

I. *On the Compression of Earth in Bank.*

It is well known to practical engineers, that when earth is excavated and formed into embankment, it occupies *less space in bank* than in the cut whence it came.

Although experience has sufficiently established this fact, yet a contrary opinion is often entertained by persons who have not bestowed much attention upon such affairs; and this idea is encouraged by inadvertent paragraphs, which are sometimes met with in works of high professional authority.*

Thus even in Professor Mahan's able treatise upon Civil Engineering, (page 118,) we find the following sentences:—"In determining the relations between the volumes of the embankments, and the excavations by which they are furnished, it must also be borne in mind that earth, in its natural state, occupies less space than when broken up; and as the embankments, when first formed, are in the state of earth newly broken up, an allowance must be made according to the nature of the soil. This allowance will generally vary between one-twelfth and one-eighth; that is, earth, when first broken up, will occupy from one-twelfth to one-eighth more bulk than it does in its natural state."

Now, so far from this being the case with embankments of earth, it is directly the reverse, and the fact is in practice, that the *compression*, and not the *expansion*, of earth, when formed into bank, is usually found to be from *an eighth to a twelfth part* of its volume in the natural state.

Although it is evident that a subject of this nature does not admit of a precise determination, because an almost endless variety exists in the consistency, and hence in the compressibility of earths; still it is quite possible to form an approximation which will not, in general, err very far.

* The most common error upon this subject, which we meet with in books, is the supposition that a certain amount of earth excavation, will form the same quantity of embankment; which, in practice, can never be the case in banks that are made with carts.

Thus in Professor Millington's excellent "Elements of Civil Engineering," we find it stated (at page 184,) that by a particular arrangement of levels, "one-half of the canal will be in excavation, and the remaining half in embankment, and the soil that is dug out of one end will serve to form the embankment at the other." The same idea runs through other works, which we might quote if it were necessary.

A few years ago the writer made some observations upon embankments formed from excavations, in three different cases, and upon a tolerably large scale, where the accurate cubic content, both of cut and bank, was known, and the amount of the latter exceeded 39,000 cubic yards.

The details of these experiments, all of which refer to banks formed in layers by cart and scoop, are to be found in the following statement, of which we may further observe, that one winter intervened between the commencement and completion of each bank.

Number of the embankment.	Earth excavated to form each embankment.	Embankment made by the preceding quantities of earth.	Shrinkage or compression of the earth in bank.	Rate of the compression of the earth in bank.
	Cubic yards.	Cubic yards.	Cubic yards.	Cubic yards.
1*	6970	6262	708	9·84
2*	25975	23571	2404	10·80
3	10701	9317	1384	7·73
Total.	43646	39150	4496	

By these tabulated observations, we perceive that 43,646 cubic yards of earth, transferred from its natural locality into the embankment of a public work, suffered by the operation a diminution, or shrinkage, in bulk, of 1,496 cubic yards, or *one-tenth* of its mass.

Some other observations, upon a smaller scale, indicated that the compression which took place in *gravelly earth*, when used for embankment, amounted to about *one-twelfth* of its bulk in the cutting.

Consequently, at least until more ample experiments are made, these results seem sufficient to justify the assumption of the following rates for the compression of earth in bank, viz.

In light sandy earth, $\frac{1}{8}$ of the volume in excavation.
In yellow clayey earth, $\frac{1}{10}$ "
In gravelly earth, $\frac{1}{12}$ "

In computations made for the purpose of equalizing the excavation and embankment upon roads, canals, or railroads, a strict attention to the above considerations is indispensably requisite; for if they are neglected, it will be found that excavations, which have been laid out as sufficient to furnish the materials for a given embankment, will be deficient in quantity, and an unexpected resort to side cutting will become necessary to complete the bank, as has been witnessed by the writer in more than one instance.

In tracing out a canal, if the depth of cutting sought by the centre line, as necessary to form the banks from the excavation of the trunk, has been calculated without due allowance for the compression of earth in bank, the trunk of the canal will not supply material enough, and a resort either to cutting below bottom, or to side trenches, will become unavoidable, to make up the amount deficient.

II. On the Increase of Rock in Bank.

By careful observations made by the writer, it was found that the excavation of 22,625 cubic yards of hard sand-stone rock, which quarried in large fragments, formed 32,395 cubic yards of embankment; showing that in this instance the increase of the rock in bank was 9,770 cubic yards, or about $\frac{3}{7}$ of its volume measured in the cut.

In another case, it was noticed that the excavation of 16,982 cubic yards of blue slate rock, that broke up into small pieces, formed 27,131 cubic yards of embankment; showing that here the increase of the rock in bank amounted to 10,149 cubic yards, or nearly $\frac{6}{10}$ of its measured bulk in the cutting.

From these observations, made upon the increase of near 40,000 cubic yards of rock-cutting carried into bank, it would seem that the augmentation was about one half: but as in lime-stone, and other rocks, it might be found to vary, both with their relative frangibility, and the dimensions of their quarried fragments, more experiments upon this point appear to be necessary to enable correct rules to be framed.

Philadelphia, September 1st, 1841.

Spark Protector.—The German journals state that an engineer of Vienna, named Klein, has invented a method of preventing sparks and ashes from the fires of the locomotive engines of railroads from falling on the passengers in open wagons, without, however, diminishing the current of air necessary for the fire. The experiments made on the Vienna railway have been so satisfactory that it has been resolved to adopt his apparatus, and to burn wood instead of coke.—M. Klein has taken out a patent for his discovery.

* Embankments 1 and 2 were yellow clayey soil, and No. 3 light sandy soil.

HINTS ON ARCHITECTURAL CRITICISM.—Part 3.

It may appear quixotic, perhaps, to raise an opposition for the sake of advancing to a point, especially to men, who, from an estimate of its worth, love their profession; still, though it would pain me so to insult the enlightened perception of many whose genius I revere, I must even assume the attitude of Cervantes' Don, and fight against impediments as they appear to stand betwixt criticism and the truth. It is from a painful conviction that architecture is beset by enemies in the guise of friends, whose opinions mostly discolour what they touch;—it is from the spirit of common disquisition afloat respecting her beautiful figures, that I have been so particular in establishing her claims, and it is also that I may help to raise her to that pinnacle which is her due, that one more part is devoted to confirm them.

Candidus, in his peculiar way, has long since taught us to infer, how that many comment on architecture, who can remark on nothing else, and if I affirm that many assume the airs of architectural connoisseurship whose coarse minds would famish on the delicacies of poetry, I am not farther from the truth than the gentleman alluded to. Let not then the man of taste question the benefit of any attempt, however humble, which has for its object to inculcate purer notions concerning an art whose monuments, above those of every other art, embody the most extensive combinations, whether of beauty or of grandeur.

In furthering my idea, then, the questionable character of proportion invites regard, since to this the student of architecture first looks, as he measures to be great. This measurement for beauty, which is now the great feature in early tuition, and which sprang originally from a desire to appreciate more fully what seemed so exquisite in design, first gave us those ideas of proportion we denominate classic. Whilst, however, we were gaining acquaintance with the treasures of antiquity, an evil was creeping insidiously in upon us, inasmuch as, that beauty herself was becoming from habit systematic, and we ourselves were in danger of ranking as engravers, rather than as artists, whilst we reduced or transferred her objects. In spite of that love of antiquity, which affected us towards the adaptation of Athenian or of Roman architecture, in spite of our admiration of parts for their intrinsic merit, an idea of proportion became engrafted on the mind, which, as it pursued either one style or other, fixed upon that mind first a prepossession towards certain division of parts, with their arrangements, to the prejudice of other division of parts, with their arrangements, until finally, this prepossession settled down into a confirmed choice for certain proportions, which were soon adhered to inflexibly. The necessities of the art, too, requiring the easiest adaptation of form, inasmuch as it was (and is) dependent upon very many contingent and urgent wants, led the architect to apply eagerly, as he did with exactness, newly discovered beauties, especially when every one admired, and when it was deemed creditable to his taste so to do. Ideas of proportion were thus formed, so that with a reducing compass, or a rule, symmetry was regulated, until amateurs, and would-be amateurs, discovering a key to elegance, learned with very little trouble how to commend or repudiate. Proportion soon became a word narrowed in definition, as habit in practice and criticism applied it; and when the complacent regard of many for ancient examples, became fanned into a stronger feeling, so as to produce a frown at what was different, then the spirit of originality fled, and proportion became sacrificed to a few favourite forms with rules to shape them, whilst the word itself was a definition only of their parts, or else explanatory of the comparisons made between those parts, and others of a natural figure. The consequence of all this was soon felt, for proportion being seen the great concern of an architect—the principle he seemed so to labour with, the spectator laughed to witness the accouchement of ideas, which resembled Æsop's mouse in their littleness. The poverty of the art was next challenged by many ignorant of its luxuriant beauties, and the professor was at last judged by a low standard, when the poetry of design was found so easily contrived; from all this has sprung that race of pigmy critics, whose buzz is so discreditable to our eloquently moving art.

It is against these and not against the artist, that I raise a feeble voice, and it is to meet the simple conclusions drawn from their crude notions of proportion, that I seek to generalize the word by extending its signification. Proportion as a desideratum in architecture, we say is evident, and we are inclined the more feelingly to assert this, because the ancients, chastening their most beautiful designs into the severity of fixed proportion, left little to the licence of unstudied art, to affix or improve.

In considering proportion, it would matter little whether, according to Burke, it be a mere negation, unless contrasted with deformity, or whether, according to Allison, it is in itself a source of emotion. I say, that it would matter little either way, provided that it be essential, were it not for certain notions entertained of it by many, which notions, arising out of habit, or want of study, cause the word to be incorrectly viewed in a composition. Proportion may be defined to be the arrangement of parts in a form, inasmuch as, according to the mutual fitness or disagreement of those parts, we have an idea of the whole, or of its symmetry; it is from this idea of the proportion, that we speak of a figure as being well or ill-formed.

It is evident, therefore, that proportion to be entertained, must require our attention given to those parts, and it is evident also, that pleasure to arise from them must vary as the power to perceive existing harmonies: but it is also evident that the mind must at the same time be thoughtfully engaged. Now, if great emotion be the effect of a composition in art, and if severity of thought be opposed to great emotion, which it is, proportion as fitness cannot be entertained for its own sake in the composition of beauty. Allison has taken considerable pains to confute the ideas of Burke upon this subject, by showing the nature of satisfaction felt from the consideration of fitness in a figure, and by arguing that if unpleasant associations (destructive to ideas of the beautiful) connected with a figure be removed, that then the fitness of parts will produce emotion. But the very necessity to have unpleasant associations removed before parts can be balanced in the mind, argues in favour of Burke, since, if our emotions in relation to beauty, being that beauty moves us and not we beauty, proportion would first of all affect us, independently of associations, were it a sharer in beauty's influence. There is undoubtedly a satisfaction felt by the mind, in discerning the perfection of figure. The anatomist might feel delight in theories, the very mention of which would shock, but it is only satisfaction that is felt, arising out of the effective exercise of our reasoning powers, or it may be extending into a livelier feeling, from the pleasure of having conquered, when by labour we have been able to discern the ingenuity or wisdom of another. This delight is an emotion different from that engendered by beauty, for it is an emotion resembling triumph. The spectator in such a case can sift his own emotion, and is differently affected to him who, viewing the beautiful, yields up his emotions and is conquered. It is no argument either in favour of proportion as being necessary to beauty, that the naturalist may deem a pig or a toad beautiful, because long study has prepared him for such a conclusion, and the mind naturally delights in perceiving that which reminds it of passed difficulties. In perceiving the harmony of contrivances, the naturalist views with the eye of habit, and feels an emotion because the *cause* of that appears which habit has made essential to his delight. Such a man from habit would view the skeleton of a woman with extacy, whilst the poet, who feels the poetry of beauty more than any one, would shudder, or mournfully meditate on the decay of beauty which he saw not. The one would see with satisfaction hollow cavities in the skull, the other would be wandering with melancholy over soft and oval features which were gone; the one would perceive the delicacy of bones and joints, the other would suggest to memory undulating and retiring beauties now no more:—the anatomist would reason, but the poet would feel. If proportion were minutely essential, our ideas would be full of it whilst viewing a building, but the reverse of this is the case. In buildings where the mind is encouraged to deep emotions, the trivialities of parts could not be entertained, for if they were, an admiration of them would change the character of deep emotion into that of mere pleasure—the grand cause of the effect being that reason is overbalanced; and hence it is, that the moment the eye becomes critical, then reason being restored, the impression is lost. In buildings, too, where the mind is more tranquilly engaged, and where the emotion is more softened, if proportion were minutely essential, we should seek out for every part to understand its relations, and be restless unless we discovered all; but how opposed is this to that law of beauty which always conceals a part and never displays the whole of her melting figure. If proportion were minutely essential, the design would be only one of contrivances, like that of a machine, which sets the mind thinking and perplexing itself before it can admire; and if we were to regard the design as we would a machine, our minds would be led from ourselves, who ought to be solely affected, to dwell on the ingenuity or skill of the contriver. It is only in severe and chaste designs, where the mind has its pleasure tempered by expectation, such as when a temple is erected to Minerva (and we contract an evenness of thought), that the idea of proportion is consecutively entertained, but the poetic sentiment is nevertheless sacrificed to this exercise of comparison, for we are more as admirers of the goddess than as beings affected by her power, our thoughts are not allowed to repose on beauty, but our repose is checked by the demand of beauty *requiring* us to admire—we are not allowed the languor of uncertainty, but we must rouse ourselves to perceive the fitness of harmonies.

My remarks tend, then, to make proportion only *indirectly* essential to a composition of beauty, and I am the more inclined to agree with Burke, because it is the *expression* of form which pleases us and first invites us to regard; and the only idea we have of fitness to the beautiful in figure, is the fitness of its expression, or of that which conveys in one unbroken harmony, ideas of delicacy, ease, grace, &c. Objects of beauty, too, although affecting to the mind, are also seen by a determination of sense, which, exquisitely acted upon by the most subtle influence, catches the spirit of a figure. Beauties in architecture are seen in this way. The beauty of the Grecian Ionic column for instance, would never charm us as it does, however well proportioned, unless a certain delicate softness of form were also apparent, which we trace in circles, cavettos, volutes, and beads. Our Creator, who, for wise purposes, has made us deeply sensitive to beauty, has given us sensations which, to be perfect, require either the accord of all our senses, or the quiescence of those unaffected; because, if one be disturbed, then the other is affected, and hence, it is in the proportion of the column, I love the sweeps and bends, because my eye wanders, sinks and reposes, like the touch, which, perchance, resting on a form of beauty, would wander, sink and repose. Besides, we sympathize to a certain extent with the object, before we think it beautiful, by giving it a personality. The poet is *wooed* by the gentle landscape, and is *kissed* by a pensive moonbeam—an ideal embrace is traced on such a mind, under such influence, with all that softness which sense in reality would feel; hence objects cannot be deemed beautiful that do not thus affect us, and hence the pig and the toad are both disgusting, spite of their proportion.

Proportion to architecture is however essential, but I do not say what are its degrees; the difficulty of explanation would be long and tedious, and beyond the narrow limits allowed me, which limits confine me to a prejudice confronting criticism, viz. that importance paid to minute divisions, to which the general sentiment of a composition is often sacrificed. Proportion in its most extended signification is expressed by fitness, and, as applied to composition, it is the adaptation of forms to some general idea, so that in their arrangement the general idea may not be broken. It is the poetry of forms, and their comparative magnitudes and altitudes, which is then required, assisted by that relative position which makes proportion in one case to be no proportion in another, and this leaves the mind open to that general emotion which *all* feel, when buildings of beauty or of magnificence appear to move or arrest them.

I do not mean, however, to say, that proportion in itself is not a source of delight in composition, for the contrary is instanced in the connoissenr, who, studying in Greece and Rome, has learned to examine critically and minutely, the exquisite parts of architectural figure found there. Habit has made his eye nicely alive to minute errors and delicate defects, or he feels an emotion in viewing their absence in forms, which careful study has discovered to him admirable in their fitness; but he resembles the anatomist, whose scrutiny furnishes his emotion. His delight is undoubtedly that of proportion, but it is a delight which springs out of severity, or habit of thought, and whilst this minuteness of thought engrosses him, it prevents the sentiment of a composition from operating on his mind. A second man might have studied the same figures, and as carefully, and yet have only discovered an expression of beauty in them. He might, too, before this, have seen the fitness of parts; but let him recur back to forms and figures, and he remembers them only by their expression, which expression it is, which makes them beautiful or sublime: and this remark is quite in accordance with taste, for, let a man be ever so cultivated, it is the expression of form which, after all, must influence the emotion of beauty arising out of figure. An idea of grace from difference of association, may be more refined in one man than in another, and his idea of loveliness may require greater delicacy of form to induce emotion; but, although the form which moves him is more symmetrical than that which moves another, it is, after all, the *expression* of the form which operates. Thus it is, that the association of the youthful artist with all the delicate chasteness of Greece, causes him to perceive expressions of beauty which a man of vulgar taste would lose. So that I do not quarrel with proportion, but only with the idea that it is entertained for its own sake in a composition of beauty. In speaking of figure, we say often, the form of such a girl is faultless:—what do we mean? We surely do not conceive the anatomy of her frame—the very emotion which induces such a remark prevents our reason from so working. What then do we mean? We mean that there is every thing in her form to express the delicate ease of beauty. An increased severity of mind in the spectator always bears a ratio to the decrease of poetic sentiment; hence it is, that an assemblage of few parts simply connected (deducting the accessories of situation) contributes to bestow on the rustic habitation its powerful charm. Finally these, and the foregoing observations, lead to an idea, already half expressed, that proportion, independently of the classification of forms, has its individuality in a whole—that it has its expression and meaning always in the extremes of a composition, and that those divisions which have no immediate connexion with its terminations, come under the head of beauty's accessories. If we look at a composition of the beautiful in nature, we shall discover our eye wandering along its principal boundaries. The idea of declension, which is an idea peculiar to beauty, will be traced along the principal lines. The foreground of a picture will conduct us perhaps to a widening landscape, which lessens as the eye advances, thence the eye will wander to a lake, lessening away, and thence to the mountains, dying into the horizon: and thus we shall find merely from those lines which suggest that unbroken idea of declension which the lover of beauty seeks, and which these lines, forming a pyramid on plan, show. Those who have watched the slight pencillings of an artist, may have discovered how this idea is sought for in his sketch, which cannot be called the mere effort of memory, because the same coincidence of idea is general, whilst nature has her pictures in every degree of aspect. All this is the proportion of a piece made up of lines, and is not to be confounded with the infinite variety of undulations and curves of the landscape, confined within a boundary, nor yet to be blended with the diversity of objects scattered in lovely confusion around.

As the argument here ceases, it may be suggested by some little critic or other, what has the gentleman proved by his labour? Has he taught the profession to become immaculate, or does all his argument tend to prove only that our ideas upon a few points are incorrect? Should such an amusing chirp be heard, it is only an unwilling argument in favour of my argument. Whenever our mind has been the subject of consideration, the most careful and philosophic spirits have exerted all their powers to detect the secret impulses which move it, nor has it been deemed by men of mighty intellect, a frivolous employment to exert every ingenuity to fix with certainty the causes operating on one simple affection of the mind. Nor can we be too careful in sifting and analyzing our minds, when we approach to consider the compositions of art, since, according to our perception of influences, so is our judgment, whilst, in proportion to the judgments of criticism, we are to judge of the refinement or debasement of that art. I can only add that proportion is essential, but it is a mere skeleton, hidden by the softest skin and concealed by the loveliest undulation, whilst it is lost to sense amidst the lights and shades and flowing dress of nature, and that architecture maintains her influence over the mind, not from the mere adaptation of parts but from her tales and pictures of sentiment.

November. FREDERICK EAST.

COMPETITION DESIGNS IN ROME.

[WHATEVER is connected with competition designs at the present moment, we consider is worthy the attention of the architect; we therefore with much pleasure give the following extract relative to competition designs, from a very interesting work recently published in Rome by Count Hawks le Grice, entitled "Walks through the Studii of the Sculptors at Rome."]

Large sums are annually expended by the Papal government on public monuments, from the sumptuous mausoleum to the simple statue; and all the treasures of art preserved in the magnificent museums of Rome are liberally thrown open to the gratuitous inspection and imitation of every artist, whatever be his creed or his country. Nor are the best means of developing artistic talent neglected. Public works are not given to a favoured few: they are placed under the direction of the Academy of St. Luke, a corporate body composed of the most distinguished artists in Europe, whose suffrages generally unite in the choice of the most competent. Hence the correct taste prevailing in every department. The most disinterested feelings are found to actuate the members of the Academy: and it has not unfrequently happened that the successful candidate has been until then one whose merit was known but to few. Such in truth was the first step made by the great Canova towards the temple of Fame; for until his genius burst forth in his famous monument to Clement XIV. in the SS. Apostoli, his name may be said to have been altogether unknown to fame. We have still a more recent instance of the impartiality with which merit is patronized in Rome even by private individuals. When the present Prince Torlonia, who is a most munificent patron of the arts, signified his intention to erect a monument to his late revered father, himself a princely patron, he invited all the artists of Rome to send in designs, which he engaged to leave implicitly to the Academy of S. Luke. The sum to be expended was considerable, but the glory to be acquired was still greater. The artists therefore entered the lists with no ordinary zeal; overtures and intrigues were not wanting; the patronage of the great was sought: but, to its honour be it told, that, deaf to every indirect influence or selfish interest, the Academy out voted itself, and resigned its own pretensions, declaring with one voice a young sculptor, 'till then unknown, the successful candidate. The noble Prince could not help expressing the apprehensions which he felt in entrusting to one of so little experience a work of so much importance: but the decision of the Academy was irrevocable, and the Prince, touched by their rectitude, not only acquiesced in their decision but advanced the necessary sums to enable the fortunate candidate to commence the work.

Under the direction of this same Academy, whose members are composed of artists of all countries without religious distinction, premiums are awarded with the same liberal spirit; and it is honourable to this country as well as to our own that, at their annual distributions, several English artists have been distinguished by prizes. The Academy has considerable funds; but the Roman Government, without assuming any right to influence its decrees, contributes largely to its maintenance. Their President is chosen without reference to creed or country: and hence we find Thorwaldsen at one time, and the Chevalier Don Solá at another time, their President. The professors of the Academy, who are at the head of their profession, give gratuitous education as well in the University as in the Orphanotrophia in painting, sculpture and architecture, and in the sciences necessary to their full development; and hence it cannot be matter of surprise that the fine arts flourish in Rome. These instructions however are not confined to Romans or Italians: they are imparted gratuitously to persons of every clime and creed. Such is the spirit of public beneficence which animates the institutions of Rome, and prompts private individuals to their imitation. In our time, for instance, the immortal Canova left behind him a tribute of munificent piety worthy of his great name, by consecrating his large fortune, the fruit of a life of toil, to the erection of a magnificent temple in his native country to the Omnipotent, from whom all talent and knowledge flow as from their source. He who promotes the arts must necessarily be hailed as a benefactor to his country, for he contributes not only to its wealth but also to its civilization.

> " Ingenuas didicisse fideliter artes
> Emollit mores, nec sinit esse feros."

Amongst such public spirited individuals must be numbered Canova, as several of his benefactions in Rome attest; amongst them must be numbered the present Prince Torlonia, who is in truth the Mecænas of his age; and amongst them stands pre-eminent the present reigning Pontiff, Gregory XVI., who vies with a Leo X. in his munificent encouragement of the arts.

COMPETITION AFFAIRS:—PADDINGTON CHURCH.

THERE are some matters in respect to which it is exceedingly difficult to make any impression on the public, except by such repeated hammering, that the very mention of them almost becomes a bore. Architectural Competition is one of them, and has been so frequently noticed of late, and apparently to so very little purpose, that many may be disposed to ask "*Cui bono?*"—what service is it to continue remonstrating against abuses, when the exposure of them seems to produce no effect whatever—neither the caution of decency on the part of delinquents, nor co-operation on the part of the profession to put down the malpractices complained of, so injurious to many of them individually, and so discreditable to them as a body?" Such is likely to be the plausible interrogation of easy indifference; and the advice couched in it is, no doubt, precisely that which the offenders themselves would wish to see followed. "It is of no use," settles the matter very comfortably.

The difficulty of putting down the abuses now so rife—the underhand manœuvring and jobbing now practiced in so many instances, that an honourably conducted competition may be considered an exception—this difficulty ought only to stimulate to greater energy, and to strong and determined measures on the part of the honest members of the profession. Or are we to suppose that these last are so insignificant in number, and are left in such a terrible minority, that their utmost united efforts for the correction of abuses would prove of no avail? If such be really the case, reform is altogether hopeless, and it is indeed of no use to expose fraudulent practices of which nearly all are more or less guilty, if the opportunity be afforded them. Still, as the profession will hardly admit such to be the case, any attempt to expose unfairness in competition may be supposed to be certain of obtaining their approbation.

The competition for the new church at Paddington does not appear to have been an immaculate one, but on the contrary, so conducted as to give rise to no little scandal. Among the competitors were several of note—Wild, Vulliamy, &c., and the fortunate one was a young architect of the name of Lindsay, whose design, which was in the Grecian style, was approved of by the committee. Mr. Lindsay was, however, doomed to be convinced practically of the truth of the proverb, "Between the cup and the lip," for incredible as it may seem, the committee afterwards thought fit to rescind their decision very cavalierly, entirely setting aside the whole affair of the competition, and appointing Mr. Gutch, a surveyor, and, as is asserted, actually one of the committee, as architect conjointly with Mr. Goldicutt. They—or one of them, but which we are unable to say—then produced the present Gothic design, the expense of which, it is understood, will not be at all under £10,000, although the competitors were limited in the first instance to £7,000; therefore it ought, at all events, to be something very superior to what was originally contemplated. How far such be really the case, is what we have not the means of judging; but if the published lithograph view may be relied on as a tolerably fair representation of the building, we think the committee have made after all an exceedingly bad bargain. In regard to style it is a mere jumble, while, looking at it merely as a composition, it is poor, trivial, and insipid.

As to the manner in which the competition has been conducted, and the original competitors treated, should there be any error or misstatement in our account of it, we shall be glad to be corrected, and to be assured that whatever the adopted design may be in itself, there was no kind of manœuvring on the part of any one in the case.

V.

Sir—Enough has already been said respecting the present system of competition, it is now high time for the profession to do something in order to redress their grievances. A Society might be formed of as many architects (I would not exclude those who practice surveying also), as would join themselves together for mutual protection, binding themselves not to compete for any building, the committee of which would not conform to certain fair and impartial rules adopted by the society; there are no doubt many gentlemen in the profession well qualified to organize such a society, and surely all honest architects would join in the attempt to remove their liability to such dirty actions as it is too well known often disgrace "respectable" committees.

I sincerely hope that the influential part of the profession will take the matter up.

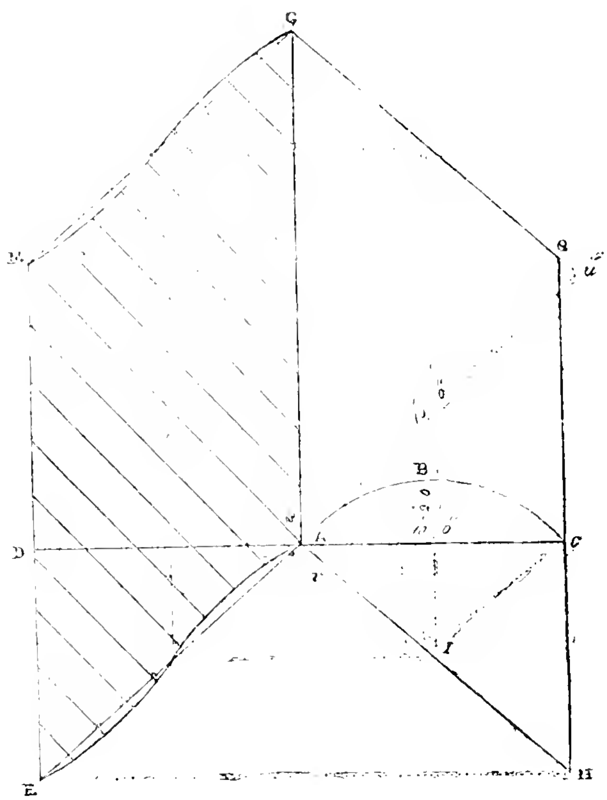
I am, Sir, your most obedient servant,

Parvo.

[We do not see the utility of any other Society than those already established in the metropolis and various parts of England and Ireland; if they would do their duty, they might, in some measure, put an end to the present deplorable state of competition. As far as we are concerned, we shall be at all times happy to give a helping hand to improve the system, but we must have the assistance of the Members of the Profession, who ought to act in *concert*, and not as now, opposed to each other.—Editor.]

ON THE CONSTRUCTION OF OBLIQUE ARCHES.

Sir—In your Journal for September 1841, Mr. Barlow in his reply to Mr. Nicholson, has thought proper to make some severe observations on the "Guide to Railway Masonry," published by that gentleman, and as I think very unwarrantably; Mr. B. only selects a small portion of that work, and because the whole of the oblique arch is not contained in his selection, he cannot award that merit to Mr. N. to which he is entitled. To take Mr. B.'s proposition, viz.: "suppose it was required to construct an oblique arch of the following dimensions, span = 10 = A. C. rise 2·5 = angle 45° = A. H. C.—Width of bridge 16 = A. U." I will now endeavour to show, aided by the instructions derived from the above publication, that the work can be correctly accomplished. Having laid down the plan and development, &c. &c. as per sketch, H Q G A and E F G A, then at page 10, Guide to Railway Masonry, will be found nearly the following directions: divide the straight line E A into nine equal parts, and let S U be respectively the eighth and ninth parts of division from E, draw F *r* perpendicular to A E meeting it in *r*, and as the point *r* falls between the eighth and ninth point, but nearer to the ninth *r*, than to the eighth *s*, join F and divide each springer line E F A G into nine equal parts, &c. Thus it will appear from the above that Mr. N. was not so "ignorant" of the fact, of the necessity in some cases of adjusting the



angle of intrado; and I believe that the first time Mr. Buck mentions the subject, is at page 9, and Mr. N. in his work, at page 10, showing that both Mr. Nicholson and Mr. Buck considered all the instructions preceding these pages, to have been preliminary. It is rather singular to find Mr. Barlow condemning Mr. Nicholson's "Approximations," when he in your Journal for October, arrives at the very same conclusion. "I guess" your readers will understand his position. Certainly no one can deny the "duty" of Mr. Barlow or Mr. C. to "expose errors," &c. Great men should be actuated by great and generous actions, and not as it appears in Mr. Barlow's case, made the means of suppressing the work of a worthy, intelligent and laborious old man. Highly creditable will it be to Mr. Barlow should he be permitted to attain to the same venerable age; could he exclaim, I too have been as useful to the artisan as a Nicholson.

I am, Sir, your's, &c.

M. Q.

York, October 8, 1841.

STEAM NAVIGATION TO THE PACIFIC BY THE ISTHMUS OF PANAMA AND ALONG THE WESTERN COAST OF SOUTH AMERICA.

(From Silliman's American Journal.)

Some interesting pamphlets on the subject named in the title were placed in our hands early in 1840 in Boston, by a brother of Mr. William Wheelwright, to whom mainly the world is indebted for an undertaking which may be with propriety ranked the first among the enterprises by steam. Mr. Wheelwright has laboured several years at this undertaking and is now on the eve of success. From himself we have just received a communication, which, although not intended for the public eye, contains many facts in which the world is interested, and we therefore venture to annex certain portions of his letter or abstracts from it.

Talcahuano, March 8, 1841.

TO PROFESSOR SILLIMAN.

Dear Sir,—I had the honour of receiving your valued favour only a day or two since, having left the United States about the time it was written, to take up the superintendence of the Pacific Steam Navigation Company, which I had previously formed in England.

Two of our steam ships, of about 700 tons each, the Peru and Chile, arrived in this port in 55 days from England, passing through the Straits of Magellan, from sea to sea, in thirty hours: sails were employed when the winds were fair, otherwise steam, and the voyage may be said to have been one of the most brilliant ever undertaken. The field for steam navigation in these seas is so ample that our first voyages came off most successfully, proving and fulfilling every statement made: unfortunately, however, the directors in England, neglecting to send a supply of coal, as previously arranged, the operations of the company have ceased, for the present, and I am now engaged in this place in mining for coal, an operation never before undertaken in this country, and which of course presents a thousand difficulties. My first object when I arrived here was to make a practical examination, to ascertain the strength of the coal, and see its influence upon our boilers and fire bars; for this purpose I proceeded south, with the double object of proving the coal and exploring Valdivia and the island of Chiloe. After some unsatisfactory experiments, we finally came to such an arrangement of our fire bars as to produce a result decidedly favourable; the excess of expenditure over the best Welsh coal was 27 per cent., which is nearly as good as Newcastle coal. The formation of clinker is great, but it is not of an adhesive character, and the fires are easily cleared; the coal seems to possess no sulphur, and there is nothing disagreeable in the smoke: the ashes are white and the coal free from smut. The coal lies in horizontal strata, rising or falling not more than ten or eleven degrees; is about three to four feet wide, and is found most generally, cropping out on the precipitous sides of hills; the upper stratum is generally soft; the next stratum, which is what I now send you, is found from twenty to forty feet beneath; and I am now engaged in sinking a perpendicular shaft for the purpose of finding a third stratum and still better coal. Some two or three cargoes of this coal have been shipped, and spontaneous combustion has been produced, which set fire to the vessels; it must be considered that the coal first used was never mined, and was taken merely from the surface. I have ascertained that in two instances the vessels which have been set on fire had vegetable matter on board—the first was a cargo of wheat stowed over a deep bed of coal: the next, the coal was shipped in what are called here *chequas*, made of grass. What influence they may have had in producing spontaneous combustion it is not in my power to say, and I should be much obliged if you could account to me for its spontaneous ignition. I cannot at present make any large deposit of this coal until I make some experiments, and for this object I shall load one or two small vessels with the coal, and watch it carefully, keeping it free from any vegetable matter, and from water, and giving it all the ventilation in my power; it is a great drawback upon my operations at present. On board the steamers we have iron bunkers for about ten or eleven days' fuel, and it causes me no anxiety in putting it on board. I had this arrangement of our bunkers made with a view of using this coal.

On my voyage south, I found at Valdivia and Chiloe the same strata of coal, and in a line of coast of more than 400 miles there does not appear to exist the slightest difference in quality. It is perhaps worthy of remark, that the coal found at Boca del Toro, on the Atlantic side of the isthmus of Panama, and near Cherokee on the Pacific side of the isthmus, is the same to all appearance as that found in this district.

I am at present mining about fifty tons a week, but hope in the course of a few days to open some more mouths, and mine in much farther than I am doing at present; my only fear is that in sinking a shaft I shall be obliged to contend with a large quantity of water. As it is a new thing and a work in which I have no knowledge, I am obliged to adopt a common sense view of it, and work on as well as I can, until miners can be sent me from England. The cost at the pit's mouth will not exceed two dollars per ton; should I get it lower down, it will be necessary to clear it of water by a steam engine, which will render it somewhat dearer. Notwithstanding our operations are paralyzed at present, I feel persuaded that by the end of this year our line of intercourse to Panama will be completed, and our communication with North America and Europe greatly facilitated.

I have no doubt that the coal beds here will bring about sooner the steam intercourse westward from Europe to Australasia: this has been a favourite plan of mine for several years, and I hope that the arrangements which I made before I left England, patronized by Sir Edward Parry, Captain Fitzroy, Mr. Montague and others, will soon go into effect. Perhaps the greatest change ever effected will be produced by opening an intercourse westward from Europe to Asia, and making America the stepping stone between them. The isthmus of Panama is destined to become one of the most interesting spots in the world; a ship canal will be formed, and it will be formed, and it will become the highway between the Pacific and Atlantic oceans. I have been frequently on the isthmus, have passed often between the two seas, have examined with much attention the facilities and obstacles which it offers for the object proposed, and have satisfied myself of the perfect feasibility of establishing a communication between the two oceans. On leaving England, I was requested to report upon my journey over, and to examine the isthmus with care, as well as the river Chagres. As it may, perhaps, be acceptable, I extract from the report such parts as I conceive may prove interesting to you.

"Having prepared myself with the necessary apparatus, I commenced by sounding the Chagres bar, where I found at low tide 14 feet of water; the river being then swollen 18 inches, left 12½ feet of water, from thence upwards to the junction of the rivers Chagres and Trinidad, (which you will find in the map in my pamphlet,) where there are four and three fathoms close to bank, which vessels might use as a pier to discharge goods. A little above the junction the water shoals to seven or eight feet—the channel below is never less than 300 to 400 feet, and often 1000 to 1200 feet; a steamer of 500 tons, properly built, might navigate as high up as the Trinidad, with perfect safety and ease; at this point it is also perfectly healthy; from this junction the distance is 28 miles to the Rio Grande, which empties into the Pacific about three quarters of a mile from the city of Panama. Vessels of any size may enter this river, as the tide rises in spring 22 feet; the space between the two points has but a very slight rise. I should say that it could not exceed 40 feet, for in passing over to Panama from Gorgona, I found there was not a hill to ascend, and that a good carriage road could be formed without making a single cut. While the land to the left towards Cruces was mountainous and broken, that to the right seemed to decline to an unbroken plane: hence, it appeared to me, that Lloyd's statement respecting that line was strictly true.

"My impression is, that the first object, before thinking of a canal, should be to make a good road from the junction of the rivers Trinidad and Chagres to the Rio Grande or Panama; by this means an intercourse between the steamers on the Atlantic and the steamers on the Pacific could be effected in three or four hours with perfect ease, and a cargo even transported in that time."

As it regards steam navigation in the Pacific, I feel convinced that it will gratify you to know, that the great work is going on. Even the few voyages made between Chile and Peru have shown, so palpably, its advantages, that the stopping of the steamers has produced a great sensation throughout the land; it is impossible to form an estimate of what it will do for these countries—the governments of Chile, Peru, and Bolivia, have granted every protection and continue to give me every support; and I am under the firm conviction that when once perfected, its advantages will be found vastly beyond what I have described them. I am very much indebted for the insertion in the American Journal of Science, of my paper on iron steamboats. I have made considerable efforts to bring forward that subject in England; I have gone into its detail and examined with all minuteness the whole subject, and I am perfectly convinced that not only all our western waters will be navigated by steam vessels built of iron, but that transatlantic steamers will and must be of iron. Mr. Brunel, the celebrated engineer of England, wrote me a letter of thanks for the paper, and promised to lay it before the board of directors of the Great Western Company, and I have reason to believe that it was mainly instrumental in bringing about the building of the great iron steamer, which will shortly ply across the Atlantic, and show herself as vastly superior to the Great Western, as the Great Western was superior to others, when she commenced transatlantic navigation.

THE PUBLIC WORKS IN FRANCE.

The following remarks on the public works in France are taken from a letter which lately appeared in the *Constitutionnel*, they present a melancholy picture of the state in which various public works have been left throughout France in consequence of the disastrous policy of "arming against all Europe," at an expense which not even the greatest financial prosperity could justify.

"The Count Daru has aptly characterized our actual situation—we commence great works on every side, and finish none. The great leading lines are scarcely sketched out, when the sums which should be destined to their completion are exhausted in opening unproductive branches. The interest of enormous capitals is lost, taxes are increased, and there is no augmentation of revenue. The generation which makes such generous sacrifices will derive no fruit from them. Canals, destined to enrich the country, are at this moment in the actual condition of lands purchased for their weight in gold, and yet shamefully remaining sterile. Each year we must recommence what was almost finished the preceding year; and, in place of diffusing wealth, we everywhere organize ruin.

"The canal from the Marne to the Rhine, for example, has been deplorably retarded. I am convinced, from a visit which I have just made to the principal industrial establishment of the department of the Meuse, of the disastrous consequences of this delay. I have seen throughout that active and laborious country a true desolation reigning. All the hopes which had been conceived of this grand and magnificent communication vanish in the saddest disappointment, and each contemplates with grief these immense works, created by an enormous expenditure, which will be doubled by this fatal interruption.

"It was in the session of 1838 that the Chambers voted the epening of this canal, which is the admirable work of the engineer Brisson. The Director-General of the *Ponts-et-Chaussées* declared that eight years at the most would be required to open this canal to the industry of the country, and, in effect, from that period down to the commencement of 1841 we must accord to the Administration the justice of admitting that nothing was neglected which could expedite the prompt completion of the work. So extraordinary was the activity which was therein exhibited that it might have been fearlessly affirmed its termination would not be later than 1846. Unfortunately, however, at the commencement of the present year, the Administration ordered a general slackening of the works, not only for the current year, but also for those which are to follow. Nay, more, it has announced that the credits allotted for the work in 1842 will be still less than those of 1841. It is easy to conceive the injurious effect of this determination, as well upon the unfinished works as upon the industry of the department of the Meuse, which reckoned upon the prompt execution of this undertaking to rescue it from the crisis which it has undergone, and which threaten now to become prolonged. It will be sufficient for me to make known the state of the works in this department, with the sums necessary to urge them forward in 1842, with a slight degree of activity, and to acquaint the reader with the sums actually voted last session. This information I have derived from the best possible sources, including the engineers themselves, to whose zeal and skill I cannot render too high a public homage.

"Setting out from the limits of the department of the Meurthe, the Marne-Rhine Canal is almost finished for a length of 17 kilometres in the department of the Meuse. The principal work is the bridge-canal on the river Meuse: this was commenced in November, 1840, and all the arches are at this moment closed. To finish this portion of the canal at the very most only the paltry sum of 300,000f. (12,000*l*.) is requisite: and this outlay would make it perfectly certain that in the course of 1843 the canal would be opened to the industry of the whole district, which would derive from it the greatest possible advantage. Well, this miserable sum it has been impossible up to this day to obtain.

"The interval between the Ornain and the Meuse, which is that portion of the canal where the works will be most tedious and expensive, has been commenced throughout its entire length. Besides the cuttings, which, according to the adjudications, amount to nearly 2,000,000f., this portion comprises the tunnel at Mauvage, which will be about 5,000 metres in length. The difficulties which arise, as well from the nature of the ground as from the great quantity of water which is met there, give every reason to apprehend that if the works are not carried on with the utmost activity the expense, which has been valued at 9,000,000f., will become doubled. From the Mauvage tunnel to Vitry le Français, where the canal effects its junction with the lateral canal at the Marne, the want of money alone prevents the immediate termination of the enterprise. What have the Chambers voted for the Marne-Rhine Canal for the current year, and for 1842? A sum of 3,000,000f., to be distributed amongst four departments. A million will be probably allocated to the department of the Meuse, which absolutely requires four.

"The result will be, of course, an enormous loss to the state. To finish the works twice the time must be employed, and perhaps twice the capital. Inevitable injuries to all the portions that are not yet finished, and indemnities to the contractors, who have engaged to terminate within a given time the portions adjudged to each, and who, having made all their preparations in consequence, have found themselves suddenly arrested in the execution of the works here, are the first only and most obvious consequences of this ruinous system.

"The point at which the most immense loss will be sustained by the Government, if the works are not resumed with pristine vigour, is the Mauvage tunnel. In point of fact all the wells, to the number of 17, several of them 120 metres in depth, are already pierced, and the galleries are commenced. The tunnel is formed of potter's clay, which easily becomes diluted in water. If the work is for a moment suspended at the end of four or five days the whole will be inundated: the wells and galleries will be filled with a liquid slime, and it will be more troublesome to repair what is done than it was to do it originally. Better never have commenced. And, yet so extraordinary was the activity at first displayed, that there was every reasonable expectation of its being finished within three years, which would have caused a saving of 1,000,000f. But, with the miserable pittance accorded by the Government to-day, no term can be foreseen either to the labour or the expense. All must be arrested, all suspended. The payment of the indemnities alone for the ground purchased will absorb the entire credit. These, Sir, are facts of public notoriety which a great number of persons engaged in manufacturing industry, agriculturists, and good citizens, would have communicated to the Minister of Public works, if, on his return from Alsace, he had visited, as we had generally hoped, this important portion of the Marne-Rhine Canal. But these sad details will nevertheless reach him, and it is surely impossible that they could escape his patriotic solicitude.

"It was easy to conceive that the 'eventualities' of war would lead to such results. Men do not reckon up sacrifices when the honour of the country requires them; but that the already brimming measure should still be filled to overflowing, when it is loudly proclaimed upon all hands that there is no longer any danger for the peace of Europe—this is what confounds and amazes every man of sense. What sort of peace is that which nips every amelioration in the bud, and disarms nothing but useful public works?"

To this powerful letter may be appended as a commentary the following paragraph from another portion of the same paper:—"So frequent is the occurrence of accidents on every portion of the works connected with the fortifications of Paris, that near each fort and detached wall there have been established temporary hospitals, at which surgeons are stationed from the different regiments employed at the works."

ON LEVELLING INSTRUMENTS.

Sir—Having observed in the Journal of this month a description of some improvements in Levelling Instruments, by Mr. T. Stevenson, may I be allowed through the medium of your widely circulated columns, to offer some observations on a subject which has engaged much of my attention.

The real practical value of Mr. Stevenson's improvements must very much depend upon the purpose for which they were designed. In some particular scientific researches, where the greatest nicety is required, and time little or no object, I can conceive a vernier adjustment both for the level and staff may be desirable. But for engineering purposes, as it is found that any slight errors in reading within the $\frac{1}{100}$ of a foot, which is the usual graduation of the staff, are not carried on and increased, but eliminated or rather balanced, in any series of observations, it is surely needless to seek greater accuracy in the scale, at the expense of much additional time and labour. And in fact, without regard to the tediousness of the operation, and the greater liability of casual mistakes, the delicacy of a vernier reading must be wholly lost and cancelled in practice, until we can command at all times a perfectly still atmosphere, and a true constant of refraction; and even with these it will be necessary to provide ourselves with a vernier adjustment for the spirit bubble—cross wires which are true mathematical lines "without breadth"—materials on which heat and moisture have no effect, and at the same time a rod, absolutely rigid, and perfect in graduation, before we can insure the nicety here sought for in the reading of the staff alone.

The real chances of error then in levelling operations consist, not in the imperfection of the instruments so much as in our powers of applying them—thus principally in the difficulty of securing at all times a perpendicular line in a long staff, from the effects of the wind or even its own weight in bending it, and at the same time the unsteadiness of the holder in handling and turning it. The dependence, indeed, under which he is placed to his staff-holder for correct results, in spite of his utmost care and attention, must be painfully felt by every accurate observer. To remedy, in part these uncertainties in handling, I have lately had constructed, under my own observation, a staff similar in graduation to those in general use, but differing in its joints and fittings, the chief object having been to obtain a length of rod tolerably unyielding, with a firm and immoveable basis.

I regret that I am obliged to speak from description only, and therefore liable to mistake; but if I rightly understand Mr. S, the whole length of his rod when extended is twice $12\frac{1}{2}$, or 25 feet, and that this is packed into a box $3\frac{1}{2}$ feet long by 4 inches square. Considerable ingenuity must be displayed in this arrangement, and great convenience obtained for travelling, but it does not say much for the strength of the staff, and with so many joints as must be necessary, I should consider that it could scarcely support its own weight in the perpendicular, much less resist the slightest force of wind: and I need scarcely add how little adapted it must be for the accuracy which the author appears to have sought in its construction.

Again: I believe it is generally admitted that the chief desideratum in a levelling instrument is a steady and secure basis, independent as far as possible of the wind, or any accidental movement. Now the ball-and-socket joint introduced by Mr. S, on which the whole weight of the level must rest cannot be considered so firm and secure as the common table-plate usually employed, and I have myself had more than one instrument of the usual construction pass through my hands, which, from not being originally well balanced and centred, has been considerably affected in its adjustment by a simple revolution on its axis—the additional weight of metal given to one side probably acting unequally on the bearing surface at different points of the circuit. How greatly must the liability of such derangement be increased when the support is thrown on the rounded surface of a ball, instead of on a strong horizontal plate.

The independence of the nature of the ground and the actual position of the legs, in setting up the stand is, however, a decided improvement *in itself*, in the plan of Mr. Stevenson, both as regards the economy of time and labour, and the usual wear and tear, and consequent irregular action of the levelling screws under the common form. In a level, which was submitted to the notice of the Institution about a month before that of Mr. S., I had endeavoured to obtain the same object by placing a small circular spirit bubble in the head of the stand itself, by which this may be brought to an approximate level, previously to the instrument being placed upon it, and this may be done upon any ground where there is standing room to use it. But at the same time a wide and steady base was deemed of so much importance, that I more than doubled the usual levelling surface of the plate, by adopting a modification of the tripod-stand for the 6 inch theodolites used by Col. Everest in the Indian survey.

Having had some experience in the use of engineering and astronomical instruments, I have ventured to trouble you with these observations, not for the sake of depreciating the ingenuity of Mr. Stevenson's improvements, but because I deem it of some importance to the profession that we should not be led to mistrust the accuracy of the instruments in common use, and thus to refine on points which in practice become non-essential, whilst we overlook what is of far more importance for correct results—the handling of the tools on which all our operations depend;

And I am, Sir,
Your's, &c. &c.,
Yarmouth, Nov. 13. George Townsend.

ON MEASURING DISTANCES BY THE TELESCOPE.

By Edmund Bowman.

[The following very interesting paper was read at the last meeting of the British Association. We consider it well deserving the consideration of the Profession, as such we have given the paper without abridgment.—Editor.]

Many years ago having had the charge of a level belonging to a celebrated engineer of the present day, while assisting him in taking levels, &c. for a bridge over a river in the north of England, my curiosity was excited (being quite a boy at the time) to know the utility of a narrow transparent scale in the field of view of the telescope, and which I afterwards conjectured was for the purpose of measuring distances. Having a few years afterwards procured a telescope level, and having made a reading staff, at that time quite a novelty, I tried a few experiments to find out what proportion, if any, existed between the distance of the object and the diameter of the field of view, when I found that, after the first 100 feet, the distances were nearly in proportion to the diameter of the field of view, read off from the reading staff held at these distances from the level—this might be in the year 1830; it occurred to me that the reading staff, when properly divided into feet, tenths, and hundredths, furnishes, by its image in the focus of the object-glass of the telescope, a much more correct micrometer scale, than any screws or a slip of any transparent substance can furnish. For instance, the diaphragm or focal aperture of a 20 inch telescope is ·39 inches, and at the distance of 10 chains it covers 1380 parts or hundredths of a foot, or 13 and 8-10ths feet; now, each of these parts is distinctly perceptible, or at least appreciable, but to divide 2-5ths of an inch into 1380 parts, so as to be equally accurate and visible, and the figures likewise equally distinct, would, I think, be no common task, be the artist who he might, and the substance divided, what it would; but could even such a thing be done, the reading-staff would still be preferable (and in any case it would be necessary to have a staff) as will appear on the perusal of this paper.

In the year 1840, about Midsummer, having procured one of Troughton's best levels, with a 20 inch telescope, I made several experiments with it with the intention of finding out, by means of careful observations, the exact relation which the diameter of the field of view bore to the distance measured, taking care, while making these observations, to keep the eye-piece to one mark for viewing the image of the staff and cross-lines stretched over the aperture of the diaphragm, and to make the adjustment for focal distance of the object-glass, as correct as the eye could appreciate; and having carefully observed the results, and with these results, and interpolating between them, having made a table of distances with their corresponding diameters or readings, I then, with the level and staff alone, took observations, connected for many miles, and after reducing the same by the above tables into distances, and summing up the whole, measured over the same ground with the chain, when the agreement between the chain measure and the telescopic measure was found very near, the difference not exceeding the [illegible]th part of the whole distance; and as part of this might possibly arise from the rating of the telescopic measure, and the other part from the inequalities of the ground, the truth might lie between these two methods.

I have also tried this method with correct surveys done many years ago, and have found it correct: field for field, fence for fence, all in their correct places, and over many miles in direct distance.

Now, since it would be very convenient, if the tables could be dispensed with, and if each reading of the staff either gave the actual distance or a proportion that could be determined—with this view I afterwards took a series of observations, with measured distances as before, but with a smaller instrument, beginning with the nearest limit of distinct vision, and proceeding by degrees to a distance of [illegible]ths of a mile; then compiled a table as before, taking care to place a mark to all those readings and distances which were actually observed and measured: upon comparing and examining these results, and those of the former table, I obtained the idea that the readings can all be made to bear a certain proportion to the distance by adding to each, be the same great or small, a certain fixed quantity or constant, peculiar to each instrument. The superior simplicity of this operation renders the tables now no longer of any use.

The cause of the inequality of the readings is the aberration of focus arising from the object or radiant point being at different distances, and the object-glass itself not being at the centre of the station. At first it occurred to me that it might be possible to enlarge and contract the diaphragm containing the image by some contrivance, with the view of keeping the image and the diameter of the diaphragm always in proportion to the inverse ratio of the distance, or what may perhaps be generally better understood, that the angular amount of the field of view might remain the same for all distances; but this has the objection, that the screws or levers by which this contracting and expanding would be effected, would be liable to get out of order, from wear and other causes, and no longer perform accurately, and even if they did so, the readings would only be in proportion to the distance from the object-glass, and not from the centre of the station or instrument.

By fixing the diaphragm and the object-glass at one invariable distance, and producing distinct vision for the various distances by having a lens or part of the object-glass within the telescope, moveable by screw adjustment two or three inches to or from the object-glass, all objects beyond a distance of 10 or 20 feet might have their images produced at the same distance from the object-glass; this method also would require reduction to the centre of the station as in the previous case, and moveover the achromatism of the object-glass would only be good at one point of its motion, and in no case be so good as with an united or cemented object-glass.

But these two methods and others have been rejected for the more simple and convenient one mentioned above, and which the following paper proposes to explain more amply, both as regards its theory and practice, and which method is simply to add a fixed quantity to each reading of the staff to make the said readings proportional to their respective distances, a small reading having thus an equal increase with a large one; the objection that might be raised to this method is this, that the accuracy of it evidently depends upon the distance between the object-glass and the focus or image of the object at the diaphragm being precise, and as the telescope, without alteration, is used as it is, this point might admit of reasonable doubt, as to extreme accuracy; but these doubts have been entirely removed by the method of determining the exact focal point for any distance, thus setting the matter at rest with respect to accuracy, and leaving nothing more to be desired.

For this method of determining distances, the telescopes upon the levels, as at present constructed, are quite sufficient; but if this meets the approbation of the scientific world, opticians will no doubt add the convenience of a scale, upon the slide part of the tube, for aberration, or determining the precise focal point for any distance: the fixed quantity or constant also can be marked upon the tube; attention being paid to the diaphragm, both that it be truly circular, and the field of view up to this circle distinct, &c., the advantages of these will appear by-and-bye.

Having made the experiments above mentioned in a public situation close to a large town, and being at the time also connected with a public undertaking, my doings, of course, did not escape observation. Some part of the public press has also favoured the idea, and as a sort of curiosity has got abroad respecting the matter, perhaps these papers, tending to explain my ideas of the matter, may not be altogether unacceptable to the public; being quite aware of much that has been written upon the subject of measuring distances by the telescope by Sir David Brewster, and other gentlemen eminent for their scientific knowledge. Yet, as the reading-staff was then little known, and as the practical surveyor, whose every day occupation such subjects must necessarily be, has advantages in this respect over the amateur or theorist, and more especially when theory does not deny him also her assistance—with this apology, I hope that this attempt at elucidation of what appears to the many, a complex subject, will meet with the indulgence which it may merit: for my own part, I can state that it is far from me to uphold or puff off anything of this kind which has not solidity for its foundation, and utility for its superstructure; on the contrary, I think that I cannot do a better service than unfold my ideas upon a subject which has been both pleasing and useful to me, and may be to others likewise.

Before I conclude these prefatory remarks, I beg leave to suggest some of the advantages peculiar to this method, and in what operations it can be applied with advantage, leaving it to the reader to supply all omissions in the list, which his practice or ingenuity may suggest.

By this method of measuring distances, the reading-staff, with a level having a good telescope, furnishes the surveyor with all the instruments required for accurately and expeditiously taking a plan and section; by this method the engineer is enabled to dispense with the assistance of the two chain-men in running a line of levels across a country; by this method the distance as well as the level is read off from the same instrument, the service of two men and the carriage of the heavy chain, &c. are saved, which, in thinly peopled districts, or where labour is both scarce and dear, are advantages not altogether inconsiderable; by this method facilities are given for running lines of levels for either geological, railroad, canal, or road purposes. For the amateur or for trial sections it is much adapted, for it is much more pleasant to be dependent upon the hire of one man than of three men, and, in many cases, the chain-men being strangers to the work, are not good to depend upon; whereas, in the other case, all that is required is the staff-holder, the engineer himself reads off the distance, for which also he himself is thus enabled to vouch; the distance taken by this method is the true horizontal distance, whereas with the chain in undulating or hilly ground, the distances taken are not the horizontal, but have to be reduced to it by the application of tables, &c. This method also has great advantages in taking levels and distances over corn fields or ground covered with crops of any kind, over gardens, rivers, bogs, or swamps, over ravines and rocky ground, and over other places, either not convenient, or difficult to go directly through from various circumstances. The convenience of this method in the above cases will be fully appreciated by the practical surveyor; in taking soundings of rivers, &c., it might be attended with very considerable advantage, as both insuring accuracy and light expense; in marine and military surveying, also, it might be applied with advantage, &c. &c.

On the Measurement of Distances by the Telescope, with both Practical and Theoretical Elucidations.

The method of taking distances is this;—if the survey is for a section, the level is first taken in the usual way; then for the distance take the number of feet, tenths, and hundredths subtended by the diameter of the diaphragm of the object-glass; that is, the diaphragm upon which the cross lines or wires are stretched; and this is readily done by screwing up the top or bottom of the said diameter to some primitive division of the staff, and then counting the divisions from top to bottom, or from bottom to top of the field of view; then this quantity of divisions read off from the staff, increased by a fixed quantity or constant (each instrument has a constant peculiar to itself), will make a sum or augmented reading which will be in every case either the distance itself, or some determinable proportion of it, depending upon the make of the instrument, &c.

The ratio of this proportion must be found by actual experiment, of which the following is an example.

With one of Troughton's 20-inch levels the reading at the distance of 10 chains from the centre of the instrument is 13·80 feet.

The constant for this instrument is ·05 feet, therefore the quantity read off must be increased by the addition of this and it becomes 13·85 feet; at one chain distance the reading is 1·335 feet, and by the addition of the constant it becomes 1·385 feet; and at the distance of the $\frac{1}{10}$th part of a chain the reading is ·0885 feet, and the constant ·05 feet added to this gives ·1385 feet for the augmented reading; it is evident that the augmented readings 13·85 feet, 1·385 feet, and ·1385 feet are exactly in proportion to the distances 10 chains, 1 chain, and $\frac{1}{10}$th of a chain. From these experiments it is evident that the quantities read off with the addition of the constant ·05 feet make augmented readings which are proportional to, or make equal ratios with their respective distances.

This constant (·05 in the above case) is dependent upon, or is a function of the principal focal distance of the object-glass, and also of the distance of the said object-glass from the centre of the instrument or station, of the diameter of the diaphragm or field of view, and also of the divisions of the staff or reading-rod.

The diameter of the diaphragm might be diminished by two screws or blunt points, projecting an equal distance into the field of view until the number of divisions of the staff included between the aforesaid points, together with a similarly contracted proportion of the fixed quantity or constant would make an augmented reading, the numerical amount of which would be precisely the same as the number of links in actual distance, and thus by writing chains and parts instead of feet and parts, the augmented readings would give the respective actual distances without any reference to proportion whatever.

And by enlarging the diaphragm upon the same principle the augmented readings in feet and parts might correspond to chains and parts, the chain in this case being composed of 100 feet instead of 100 links of the common size.

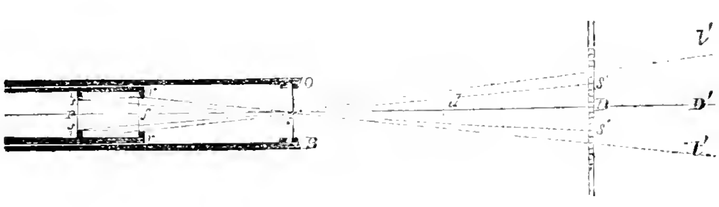
In the actual experiments where 13·85 feet corresponded to 10 chains the constant was ·05; but when the diaphragm is contracted so that 10 feet correspond to 10 chains in distance, or as each foot of the staff is divided into 100 parts, then 1000 such parts give a distance of 1000 links, and the fixed quantity undergoing a corresponding reduction likewise, it will become ·036 feet, but for general purposes ·04 feet will be quite near enough, for 1385 : 1000 : : ·05 : ·036 or ·04 nearly.

Having the augmented readings to correspond with the actual distances is no doubt a very great convenience, and it ought to be attained in new instruments, though there is very little inconvenience in making a scale to suit any proportion, the scale for parts being, as in the case above, to the scale for links in the proportion of 1385 parts for every 1000 links, and, for my own part, I prefer keeping the diaphragm as it is, for the greater the angle or number of divisions of the staff read, the less value each becomes with respect to distance, and, consequently, any error arising from the staff becomes of proportionately less value when reduced into distance.

The constant ·05 in the above example is the correction arising from aberration of focal distance, and the correction arising from the object-glass not being in the centre of the station conjointly; and first, the correction arising from the aberration of focal distance may be explained in the following manner:—

Let OcB be the object-glass of the telescope, f and d the principal foci, or foci for parallel rays, or rays from very remote objects, and let $t'D't'$ be supposed to be very remote, let F be the focus for rays proceeding from an object or radiant point D at no very great distance from the object-glass OcB, but beyond its principal anterior focus d. (See fig. 1.)

Fig. 1.



Now by optics the formula for aberration is

$$\frac{\text{Principal focal distance} \cdot \text{principal focal distance}}{\text{Distance of object from object-glass} - \text{principal focal distance}} = \text{Aberration}$$

$$\text{or} \quad \frac{fc \times cd}{cD - cd} = Ff$$

Now $eD = ed + dD$, therefore $ed = Ff$: dD and therefore $Ff : fe : : ed : dD$ and by composition $Ff + fe : fe : : ed + dD : dD$ or simply $Fe : fe : : eD : dD$

Now the aperture of the diaphragm which limits the field of view is unchangeable in diameter in any part of its motion, and it is evident that while it is at f it subtends or includes the angle tet or $t'et'$, and while at F the angle ses or $s'es'$, and that while at F the diaphragm ought to be enlarged to the size $tsFst$, to include the same angle that the same diaphragm rfr does at f, and to read off a portion of the image of the staff, which would be always proportional to the distance, for the angle remaining the same, the tangent varies as the radius, or the subtense of the angle as the distance.

Now because the number of divisions of any staff $s'Ds'$ or $t'Dt'$ forming the subtense of any fixed angle $t'et'$ is greater or smaller exactly in proportion as the distance of the said staff from the angular point e is greater or smaller, it is also evident that the diaphragm rfr or sFs will, while at f, show a larger angular proportion of the image of the staff than it does while at F, and that the proportion will be as tFt : sFs or as tF to rf, but $tF : rf : : Fe : fe$ and it has been shown that $Fe : fe : : eD : dD$, therefore by inverting $dD : eD : : sFs : tFt$, and since $tFt = sFs + 2st$ then $dD : eD : : sFs : sFs + 2st$, that is to say, the distance of the staff from the anterior focus d of the object-glass is to the distance of the same staff from the object-glass as the actual reading of the staff is to the reading augmented by a quantity $2st$.

$$\text{Now } dD : eD - dD : : sFs : sFs + 2st - sFs,$$

$$\text{or simply } dD : ed : : sFs : 2st.$$

That is to say, as the distance of the staff from the anterior focus of the object-glass is to the principal focal distance, so is the actual reading of the staff sFs which is the only part of the image visible through the diaphragm to the quantity $2st$ which makes when added to sFs (the actual reading) an augmented reading tFt,

$$\text{Now } dD : sFs : : ed : 2st, \text{ or } \frac{dD}{sFs} = \frac{ed}{2st},$$

$$\text{Again } dD : sFs : : eD : tFt, \text{ or } \frac{dD}{sFs} = \frac{eD}{tFt};$$

$$\text{therefore } \frac{dD}{sFs} = \frac{ed}{2st} = \frac{De}{tFt}.$$

Now eD and dD may be any quantities whatsoever, and as tFt and sFs vary respectively as eD and dD, therefore tFt and sFs are also variable quantities, and may be of any dimensions; but ed, the principal focal distance, is an invariable quantity, therefore $2st$ is also an invariable quantity, for it varies as ed varies, the variation of which is nothing; therefore, the variation of $2st$ is also nothing, or $2st$ is a constant quantity.

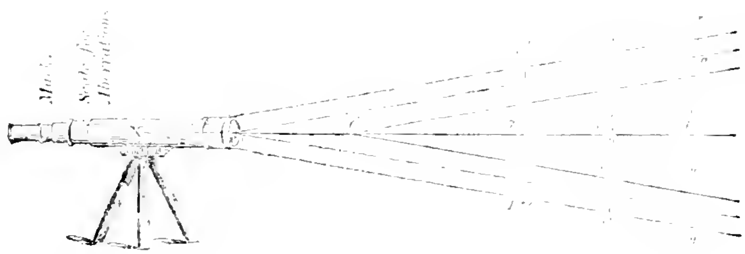
To find practically this constant quantity $2st$ for any telescope and staff, which $2st$, when added to the reading, makes an augmented reading always proportional to the distance of the object from the object-glass of the telescope. First adjust the eye-piece to distinct vision of the cross lines upon the diaphragm, and mark the sliding part of the eye-piece, so that it may afterwards be kept to the same point; then on some clear night, observe carefully some star or planet, and when by moving the slide of the object-glass a little to and fro, the sharpest and most clearly defined image of this star or planet has been obtained, mark carefully this point upon the slide of the object-glass as the adjustment for the principal focus, and as the highest limit of a scale to be afterwards graduated upon this slide; the telescope being kept at this adjustment, the distance between the cross lines on the diaphragm and the object-glass will be the principal focal distance fe or ed. (Fig. No. 1.)

Then the instrument being fixed in any convenient open place, measure any distance eD, and observe the reading sFs, the image of part of the staff seen over the diameter of the aperture of the diaphragm; then as dD, that is to say, the distance eD less the principal focal distance, is to the said reading, so is the principal focal distance to the constant $2st$, which, when added to the reading, makes an augmented reading, which is always proportional to the actual distance of the object from the object-glass; but as it would be more convenient still to have a fixed quantity or constant to make the readings when augmented by it always proportional to the distances from the object to the centre of the instrument or station, and that such a quantity exists may be found out by accurate experiments, and may also be thus demonstrated.

Let X be the centre of the instrument or station (see Fig. No. 2); let e be the object-glass; let d be the anterior principal focus of the object-glass; let D be any distance beyond this focus; and let rDr represent the portion of the staff visible over the diameter of the diaphragm of the telescope, or as it is called simply the reading; it has been shown that the reading rDr varies as the distance dD varies; from the centre of the object-glass e, draw et, et parallel to dr, dr, and from the centre of the instrument X draw Xw, Xw parallel to dr, dr, and produce Dr, Dr, to t, t and w, w, then by similar triangles,

$dD : rD : : eD : tD$, now $2rD = rDr$, and $2tD = tDt$, and by transposing, &c., the above proportion $dD : eD : : 2rD : 2tD : : rDr : tDt$, but it has been before shown that $dD : eD : : rDr$, or the reading: to the reading + a constant quantity; therefore tDt = the reading + the constant, and it is equal to $rDr + 2rt$, therefore $2rt$ is the constant corresponding with $2st$ in Fig. 1.

Fig. 2.



Again, by the construction (similar triangles, Fig. 2) it is evident also that $dD : XD : : rDr : wDw$, or as $dD : Xd + dD : : rDr : rDr + 2wr$,

and by subtraction $dD : Xd : : rDr : 2wr$, or $\dfrac{dD}{rDr} = \dfrac{Xd}{2wr}$, now dD and rDr are variable quantities and vary as each other, but Xd is for the same instrument an invariable quantity, and as $2wr$ varies as Xd varies, therefore $2wr$ is also an invariable or a constant quantity, and it is the amount which must be added to the reading rDr to make a quantity wDw, which shall be proportional to the distance of the object from the centre of the station, or by a suitable construction of the diaphragm the quantity wDw shall be the actual distance itself.

From the inspection of Fig. No. 2, it is evident that if the parallel lines be produced beyond wDw, and lines $w'D'w'$, $w''D''w''$ &c. be drawn parallel to it, that the readings $r'D'r'$, $r''D''r''$, &c., will increase or diminish as the distances dD', dD'', &c., while the quantity $2wr$ will remain constant and always equal to $2w'r'$, $2w''r''$, &c., which by the construction of the figure, are all equal from the point d where the readings of the staff begin, or are at Zero.

Taking a practical example with the telescope of the 20 inch level before mentioned, the distance ed measures 18·5 inches, or 2·33 links, the distance Xe, or from the object-glass to the centre of the tripod, is 1·27 links, therefore the whole distance Xd is 3·6 links. Now, when the staff is held at 1000 links or 660 feet from the centre of the instrument, or $1000 - 3·6 = 996·4$ links from the point d, the reading is 13·80 feet; now here $dD = 996·4$, $XD = 1000$, $rDr = 13·80$ feet, and it is required to find wDw and the constant $2wr$.

$$\text{Now } dD : XD : : rDr : wDw, \text{ or}$$

$$996·4 : 1000 : : 13·80 : 13·849 \text{ or } 13·85 \text{ nearly}$$

and because $wDw - rDr = 2wr$, therefore

$13·849 - 13·80 = ·049 = 2wr$, or the constant which equals ·05 nearly, and the augmented reading is 13·85.

Again, taking another example at the distance of 200 links, 2·72 feet were read off, now $200 - 3·6 = 196·4 = dD$, and $196·4 : 200 : : 2·72 : 2·769$ or 2·77 nearly and $2·769 - 2·72 = ·049$ or ·05 nearly, which is the constant as in the former case, and the augmented reading wDw in this case is 2·769 or 2·77 nearly.

Therefore ·05 is the constant number to be added to each reading to make augmented readings proportional to the actual distances, when this instrument and staff graduated into feet and decimal parts, &c. are used.

The scale for this instrument is, therefore, 1385 divisions, each the $\frac{1}{100}$th part of a foot, corresponding with 1000 links in distance, and therefore to plot a section at the rate of 2000 links to the inch, the scale will have to be a 27·7, instead of a 20 to the inch, when the divisions of the scale will plot the readings in distance.

The diameter of the diaphragm of this telescope is ·39 inches, but by fixing screws or points on the circumference of this diaphragm, the diameter of this aperture might be contracted, so that the distance between the points of the screws might not exceed the proportion of 1000 divisions of the staff to 1000 links in distance; but as the advantages peculiar to each (that is, whether it is best to keep the instrument as it is, and read off proportional distances only, or reduce the diameter and read off actual distances,) have been treated of before in this paper, it is quite unnecessary here to go over the subject again.

A smaller level with an inverting 10 inch telescope, gives with the same staff the constant quantity (from the centre of the station) ·07 feet.

The principal focal distance of this telescope is 10·5 inches, the diameter of the aperture of the diaphragm ·53 inches, the distance of the object-glass from the centre of the tripod 6·4 inches;* by this instrument 1000 links in

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* Here it may be observed, that the distance between the object-glass and the centre of the instrument ought to be invariable, and that the increas

distance are measured by 33·3 feet, and of course under four or five chains distance, the reading staff or ordinary dimensions will be very convenient; but with the 20 inch level erecting telescope, 1000 links in distance are read off by 13·8 feet, therefore a 14 feet staff is very convenient for this telescope for all distances under 10 chains, and by having a longer staff, or by taking a semi-diameter or other known proportion of the diaphragm, the length of the observed distance may be increased at pleasure, and be limited only by the power of the telescope to read the staff distinctly. Taking facility of reading the staff and the consequent accuracy of the observations for ordinary levelling operations into account, distances not exceeding from 3 to 5 chains for the small 10 inch level, and from 7 to 12 chains for the large 20 inch level described above, are the best and most convenient, as insuring speed with most accuracy; but any distance, down to 12 feet by the small level and 20 feet by the large level, can be found quite accurately; at distances smaller than these, the range of the sliding tube is too short to admit of distinct vision, but it is not important to have this range increased, as distances smaller than these are not often required, and when so, the levelling rod furnishes the ready means of ascertaining the amount by direct application.

The large telescope, with the erecting eye-piece, is decidedly superior for the purpose of measuring distances to the smaller one; but care must be taken that the diaphragm of the object-glass is not at all intercepted by the diaphragm of the eye-piece, which is nearer to the eye, and this can easily be found out by illuminating the diaphragm of the eye-piece by a piece of white paper, and then by giving the eye-tube a motion in its slide to or from the diaphragm of the object-glass. By this means the two diaphragms will become apparent, and if, when the eye-tube is fixed at the proper adjustment for viewing the cross-lines, the diaphragm in the eye-tube intersects in the smallest degree (for these circles are not always concentric) that of the object-glass, or with the cross lines, then the diameter of this latter must be contracted by points or screws projecting at equal distances into the field of view, so far as to clear the inner circumference of the diaphragm of the eye-piece, and these screws, when driven to their proper places, must be so firmly fixed that they will not readily be disturbed. No doubt the fine lines of a spider's web, or very fine wire, might answer the same purpose; but as the eye-tube in the generality of good telescopes of this sort has to be taken out and replaced on every occasion of its use, it is difficult to divest the mind of the possibility of the lines being disturbed by this motion, whereas in the case of the inflexible metal of the diaphragm no such objection can possibly hold good; moreover, the cross lines serve as a guide to find the true diameter. Opticians have been in the habit of placing two parallel upright lines, and at right angles to these a horizontal line, in the field of view of the telescope, and some people have the idea that these may be used for the purpose of distances, but besides the objection stated above they have two very serious objections—the first is that they should have been horizontal for this purpose, and the second is that they are much too close together and include much too small an angle to give more than an approximation to the distance, and it may be added, that they never were intended for anything of the kind, but probably only as a guide to keep the reading staff vertical while taking levels, but in the case of extraordinarily long distances these cross lines may be serviceable in taking semi-diameters, &c.

The constant quantity for the 10-inch level being ·07, and for the 20-inch level ·05, and as these telescopes or levels are nearly of the smallest and largest sizes used for general purposes, the constant in feet for a medium size may be somewhere at about ·06 feet.

In favour of this method of observing distances it may be mentioned that with the telescope of the 20-inch level, and with no further adjustment for focal distance of the object-glass than what appeared at each observation to be distinct vision, distances can be taken of many miles by the accumulation of distances such as those required in levelling; that is to say, not often less than 20 feet, often averaging 8 chains, and seldom so much as 20 chains, with quite as much accuracy as by the common method of the chain. The superior accuracy of the measurements taken from the reading staff during the process of levelling a circuit of many miles and returning to the same point, when, on balancing the numerous rises and falls, the near agreement within an inch or so proves the accuracy of the work, also favours the idea that this method of measuring distances is capable of great accuracy, for the self-same staff is used, and the vertical position is the most natural and least difficult to find, and the level itself gives the telescope the horizontal direction. From all these causes, and from the perpetual inequality of the ground in chaining, there can be no doubt that, on these heads at least, this method has superior claims to the chain in point of precision, and as a further refinement, will be especially of great service to those telescopes whose defining power is not of the first-rate description, and, for any telescope, removes all doubts of want of precision.

Let the aberrations for focal length for every distance of the object be graduated upon the slide of the large tube, from the principal focal mark before mentioned to the extremity of the slide. The aberration or distance from this principal focal mark is found thus.

[illegible]gth of the focus for near objects ought to be obtained by having the rack and slide adjustment behind the centre, and not in front; from this it appears that those tubes which move at the object-glass, are not precisely adapted for this method, inasmuch as the increased distance of the object-glass from the centre of the station would, for the short distances, increase the length of [illegible], and of course the constant would have to undergo a similar increase, which would be absurd.

Without referring to the former figures, the principal focal distance is generally called F, and the distance of the object from the object-glass is called simply D, and these two being given, the aberration which is called e is found by the formula in optics, which is this:—

$$\frac{F^2}{D-F} = e$$

From this formula, a table of aberrations can be calculated for as many distances as the short slide of the tube is capable of receiving, and of having graduated upon it; but what would be better still, instead of or in addition to the scale for actual distances, would be to have a scale of readings of the staff; or in other words, the adjustment for focus should correspond with the reading of the staff.

Now, it has been shown that the reading of the staff varies as $D-F$ varies; but $\overline{D-F} \times e = F^2$; now F^2 is a constant quantity, and $D-F$ is a variable quantity, therefore e is also variable, and as the product of these two variables is always a constant quantity, it follows that e varies inversely as $\overline{D-F}$, therefore also e varies inversely as the reading of the staff; that is to say, when the rays are parallel and the distance infinite, and consequently the reading infinite, then the aberration is Zero, or at the principal focal mark; again, when the reading is at Zero and $D-F=0$, or $D=F$, or when the staff is held at the principal anterior focus, then the aberration is infinite; again, taking the case when $D-F=F$, then $e=F$; for $D-F \times e = F^2$, and also $D=2F$; that is to say, when the distance is twice the principal focal distance from the object-glass, the aberration e and focal distance F are equal.

Now, because the aberration varies inversely as the distance $D-F$.

When $D-F=0$,	the aberration is	Infinite.
When $D-F=F$,	the aberration is	F
When $D-F=2F$,	the aberration is	$\frac{F}{2}$
When $D-F=4F$,	the aberration is	$\frac{F}{4}$
When $D-F=100F$,	the aberration is	$\frac{F}{100}$
When $D-F=$ infinity,	the aberration is	Zero.
&c. &c.		&c.

Now, the readings, always varying as $D-F$, will be proportional to Zero, F, $2F$, $4F$, &c., and the aberrations for these readings to infinity, F, $\frac{F}{2}$, $\frac{F}{4}$, &c. This furnishes a very ready method for graduating the sliding tube of the telescope with the aberrations for the different readings which must be marked thereon in figures.

Taking a practical example, the large telescope of the level ($18\frac{1}{2}$ inches principal focal length) when the slide is out 1·6 inches beyond the principal focus, or nearly its extreme length, making the augmented focal length 20·1 inches; then when the reading is properly taken for this adjustment, that is to say, the staff held at the requisite distance for distinct vision, the reading is found to be ·40 feet.

Then, since the reading varies inversely as the distance, the following shows how a table of aberrations for any reading may be constructed, thus,—

When the reading is	The aberration at ·40 into the inverse ration of the reading		The aberration from principal focal point in inches.
·40 feet	$1·60 \times \frac{40}{40}$	gives	1·60
·50 do.	$1·60 \times \frac{40}{50}$	gives	1·28
·60 do.	$1·60 \times \frac{40}{60}$	gives	1·066
·80 do.	$1·60 \times \frac{40}{80}$	gives	·80
1·00 do.	$1·60 \times \frac{40}{100}$	gives	·64
1·60 do.	$1·60 \times \frac{40}{160}$	gives	·40
4·00 do.	$1·60 \times \frac{40}{400}$	gives	·16
8·00 do.	$1·60 \times \frac{40}{800}$	gives	·08
16·00 do.	$1·60 \times \frac{40}{1600}$	gives	·04
32·00 do.	$1·60 \times \frac{40}{3200}$	gives	·02
&c.			

Now, the reading of 32 feet corresponds with a distance of 23 chains; so then at a distance of little more than a quarter of a mile the aberration is only the $\frac{1}{50}$ part of an inch, and at 46 chains the $\frac{1}{100}$ part of an inch. Beyond this distance, therefore, the principal focal mark will be quite near enough without any further subdivisions: for, although they can be carried to any wished for degree of minuteness, yet supposing that the adjustment for focal distance was not nearer than the $\frac{1}{100}$ part of an inch, the size of the image being exactly in proportion to the focal distance, and this distance being supposed to be in error by the $\frac{1}{100}$ part of an inch, then the $\frac{1}{100}$ part of an inch over a space of 18·5 inches is only the $\frac{1}{1850}$ part of the whole, and when the focal distance is 20 inches, the $\frac{1}{100}$ part of an inch will be the $\frac{1}{2000}$ part of the whole, and thus the reading, and consequently the distance, true to the $\frac{1}{2000}$ part of the whole.

For the sake of rendering the demonstration more simple, the scale above is shown how it can be deduced from one observation alone; but as one observation cannot have the accuracy which the mean of a greater number will have, it will be better to observe correctly other readings also, such as 1·00, 2·00, 3·00, 4·00, &c., and mark these points likewise, and by taking the mean of the whole, the scale can be made as accurate as it is possible to graduate it. The smaller divisions of the scale can be filled up by the assistance of the rule—"that the aberration varies inversely as the reading."

The tube of the telescope being thus graduated, and having found the best adjustment for the eye-piece to view the cross lines, mark upon the slide of the eye-piece this adjustment also, and let the eye-piece be always set to this mark on every observation. As this adjustment is important, and though mentioned before and understood to be done previously to taking the observations for the scale of aberrations, the repeating the caution here may not be considered altogether uncalled for.

The telescope being levelled, is now prepared for taking distances; the staff being held at the distance required to be measured, the object glass of the telescope is brought to as near the proper focus or distinct vision as the eye of the observer can appreciate, the divisions of the staff counted and the sum or reading taken; then, having got the reading, look at the slide of the telescope, and if the focal adjustment points to the same figure as the reading is, which it generally will do, then the reading first taken is correct, and only requires the addition of the fixed quantity to make it the actual distance itself; or in any case a proportional measure of the distance, if the divisions of the staff do not correspond exactly with the divisions of the measure for distance, but if they do correspond, then the augmented reading is the distance itself.

But if the slide shows a reading greater or less than that read off from the staff, then the first adjustment for focus by the eye has not been sufficiently precise, and the slide must be adjusted to the same figure as the reading of the staff exactly, and then the reading observed again through the telescope and taken; and this approximating process can be repeated as often as required, but once will always insure sufficient accuracy for ordinary purposes, and even this once will, in many cases, not be necessary; this corrected reading, then, with the addition of the constant, will give the distance either actual or proportional as the case may be.

By this process, after the first correction if required, a degree of precision will be attained so as to leave nothing more to be desired on this head; and by repeating the process, the smallest imaginary quantity of error may be got rid of, and thus the uncertainty as to which is the true focal point for any distance is removed, and all cause to doubt the accuracy of this method obviated.

Take a practical example with a 20 inch telescope, by rendering the focal distance precise to the $\frac{1}{500}$ part of an inch; now there being 10,000 such parts in 20 inches, the greatest error in distance will only amount to the $\frac{1}{10000}$ part of the whole distance, and in taking a great number of distances, there is no reason to suppose that even these minute errors should be more on one side of the absolute truth than on the other side. It follows that in the aggregate of these distances, even such minute errors will vanish by mutually counterbalancing each other, this being the case then, even with the adjustment for focus by the eye alone, and without the first approximating process, a very near approach to the exact distance is obtained in the long run, and by the approximating process, a degree of precision will be attained far exceeding that by the common or direct process of the chain, and the more especially on uneven ground.

PROJECTED RESTORATION OF HEREFORD CATHEDRAL.

In May last Mr. Cottingham made a discovery in Hereford Cathedral which, while it adds greatly to the interest of that venerable fabric, furnishes a valuable addition to the instructive and pleasing remains we possess of the architecture of the 11th century. The discovery referred to was made on taking down the modern Italian wainscot screen, of the Corinthian order, erected by Bishop Biss 120 years ago, enclosing the whole of the ancient remains of the east end of the choir. The screen, on being removed, was found to have completely shut out the view of the Ladye Chapel, which must once have possessed surpassing excellence. The beautiful drawing of the restoration, just published by Mr. Cottingham, presents to us an architectural gem of the first water. It consists of a Norman arch, above which are three Gothic windows, and between the windows and the arch, a screen or belt. The arch occupies nearly the whole width of the east end of the choir, and is very massive; it is decorated with foliage and zigzag mouldings. The arch is supported by four columns, with rebated pilasters, the capitals being highly enriched with foliage and sculpture, the latter presenting curious devices to represent the security and triumphs of the Christian. The belt running above the arch is composed of 24 semi-Normal columns. The three windows are of the early pointed style, and have evidently been formed since the erection of the building by cutting away the Norman groining to introduce the Gothic, which at the time was rising in favour. The three windows throw a flood of light on the beauties of the choir. At the time of making the discovery Mr. Cottingham found in the wall, just above the belts, five apertures of the early English age, completing the narrow walk all round the choir.

On looking into the Ladye Chapel from the high altar, a beautiful and unequalled effect is seen to result from the presence of two columns, which stand in a line with the centre of the Norman arch, and support the early English groining which connects the north and south transepts, the capital of one being of the Norman, and that of the other of the early English age, but both erected at the same time.

This discovery is highly important, as it adds to the proofs already obtained that by slow degrees the heavy semi-circular Norman arch has passed into the light and pointed Gothic. The evidence of this fact is quite clear on comparing the upper with the lower part of Mr. Cottingham's drawing, and also on noticing the difference between the capitals of the two pillars at the entrance of the Ladye Chapel. It is much to be desired that the beautiful restoration designed by Mr. Cottingham may soon be realized, as it will furnish to every admirer of cathedral architecture a treasure of unparalleled beauty. The necessity for the extensive repair of the whole cathedral is but too obvious. The tower, which has long been in danger of falling, is even now in little better than a state of jeopardy, being shored up by a series of timbers 13 inches square, so as to support the whole superincumbent weight, while the defective piers are cut out and reinstated. It is gratifying to find that the people of Hereford are fully sensible of the value of their venerable cathedral, and that they nave wisely avoided allowing party politics to interfere with the design of effecting its thorough and tasteful reparation. The antiquarian skill and taste of the dean (Dr. Merewether), combined with the zealous co-operation he receives from the canons of the cathedral, and from the clergy and gentry of the neighbourhood, give a most encouraging prospect of success, while the professional experience of Mr. Cottingham is a voucher for the restoration of the sacred structure to its pristine beauty and magnificence.

The work is one of more than local interest, it is important to the whole kingdom. Our antique buildings cannot be regarded as an insignificant part of our national wealth. They show that we are not of yesterday and they link us to the past. There is, indeed, a share of sanctity in the feeling that would prompt us to shield from the despoiling hand of time the monuments of those ancestors from whom we have received our being, our social institutions, and many of our sacred privileges.

Let the appeal for the requisite funds, therefore, not be limited to the county or the diocese; let an opportunity of sharing in the work be afforded to the taste and liberality of the country at large, and it will soon be found that these time-honoured structures have friends everywhere throughout the country, from John o'Groat's-house to the Land's-end.

Martyrs' Memorial.—Those of our readers who live at a distance from Oxford, and who take an interest in the completion of the Martyrs' Memorial, will be gratified to learn that great progress has been made in the works during the last three months, notwithstanding occasional impediments from the unfavourable state of the weather. The cross has been raised to about two-thirds of the height of the first stage or division of the shaft, which forms the base of the niches for the statues; and though much of the detail in the ornamental carving is of necessity left for the present in a rough state, till the upper portion of the cross is completed, yet sufficient is expressed to give a very good idea of the rich effect which will be produced when the whole is finished. At one time we were somewhat apprehensive lest the colour of the stone should prove darker than we had been led to expect; but we have been assured by competent authority that this partial discolouring will readily pass off as the stone becomes more exposed to the action of the atmosphere: and this result has already taken place in the lower part of the base, which was first laid down. We believe a similar effect may be observed in the new Houses of Parliament, in which the same description of stone is being used; the upper courses, which have been recently laid, appear for some time discoloured, while those in the lower part of the walls, having been longer exposed to the air, have already nearly assumed their natural tone of colour. The exterior walls of the Martyrs' Aisle, as well as of the east end of the centre aisle, which it was necessary to take down and rebuild, in order to throw open the whole line of the Martyrs' Aisle in the interior of the church, have been sufficiently advanced to enable the workmen to commence laying the slates upon the roof. A considerable portion also of the ornamental parts, the finials, pinnacles, and the pierced parapet, has been set up. The general effect of this aisle, when completed, will be very striking; and we do not hesitate to say that it will be one of the most beautiful specimens of ecclesiastical architecture in this city. The workmanship also appears to us to be very well executed. The rebuilding of the east end of the centre aisle has rendered it necessary to make extensive repairs to other parts of St. Mary Magdalen Church. The gable of the adjoining aisle was found to be in so defective a state that it was necessary to take it down without delay; and it has been rebuilt in a style corresponding in its general character with the other new work, but it is not so much ornamented in detail as the other gables. We understand also that the flat plaster ceiling of this aisle is to be removed, in order to open to view a handsome wooden ceiling in panels, which is above it. But these, as well as some other alterations to improve the general character of the interior of the church, will be effected entirely by separate subscriptions, raised specifically for this purpose, and which are wholly independent of the subscription to the Martyrs' Memorial. We regret to add, that we understand the sum of 700*l.* is still wanting in order to meet the engagements of the committee for the Martyrs' Memorial. We believe that some additional expense has been incurred in sinking the foundation of the cross to a greater depth than was at first thought might be sufficient, in order to obtain a firmer basis, as well as in providing a more durable description of material for the foundation, according to a provision in the contract, as what was to be obtained in this neighbourhood was not deemed sufficiently good by the architect.—*Oxford Herald.*

NEW INVENTIONS AND IMPROVEMENTS.

CALOTYPE.

Abstract of the specification of a patent granted to William Henry Fox Talbot, Esq., of Lilcock Abbey, Wilts, for improvements in obtaining pictures or representations of objects.—Enrolment Office, August 8, 1841.—The best and smoothest writing paper is washed on one side with a camel hair brush dipped in a solution of 100 grains of crystallised nitrate of silver in six ounces of distilled water. The side being marked, to know it again, the paper is dried before a distant fire, or in the dark, after which it is dipped for a minute or two in a solution of 500 grains of iodide of potassium in a pint of water; the paper is then dipped in water and dried. It is now called iodised paper, and kept in a portfolio for use. Immediately before using, this iodised paper is washed on the marked side with the following mixture:—100 grains of nitrate of silver are dissolved in two ounces of distilled water, to which solution one-fourth of its volume of acetic acid is added. A saturated solution of crystallised gallic acid, or the tincture of galls, is mixed with the foregoing in equal volumes, forming gallo-nitrate of silver. After being washed with this mixture, the paper is dipped into water, it is then dried lightly with blotting paper, and finished by a distant fire. These operations should be performed by candle-light. This paper, which the inventor calls "Calotype Paper," is used as follows:—A sheet of the paper is placed in a camera obscura, so as to receive the image formed in the focus of the lens. If the object is very bright, or the paper is exposed a sufficient time, a sensible image will appear on the paper when removed from the camera obscura. But when the object is "invisible or dimly seen," it is brought out in the following manner:—The paper is washed over with gallo-nitrate of silver, and held before a gentle fire until the picture is sufficiently distinct, which is then fixed in the following manner:—The paper is first dipped into water and partly dried with blotting paper, after which it is washed with a solution of 100 grains of bromide of potassium in eight or ten ounces of water; after which the picture is again washed with water and dried. In the picture thus obtained, the lights and shades are reversed, but another being taken from it restores their natural position. For this purpose a second sheet of calotype paper—or the patentee prefers using common photographic paper—is placed in contact with the picture, a board placed beneath and a sheet of glass above them, pressed into close contact by screws. On placing them in the sunshine for a short time, a picture with the lights and shadows in their natural position is produced on the second paper, which is to be fixed as before directed. After frequent copying in this manner, a calotype picture sometimes becomes faint, to prevent which, it is to be washed by candle-light with the gallo-nitrate of silver. A second improvement consists in a mode of obtaining positive calotype pictures, *i. e.*, with the lights and shades in their natural position, by a single operation. For this purpose a sheet of calotype paper is exposed to the daylight until its surface is slightly browned; it is then dipped into the solution of iodide of potassium, by which the browning is apparently removed. On being taken out of this solution, the paper is dipped in water and slightly dried, it is then placed in the camera obscura and pointed at an object for five or ten minutes. The paper is then removed, washed with gallo-nitrate of silver, and warmed, when a positive image will be produced. A third improvement consists in producing photogenic images on copper; a plate of polished copper is exposed to the vapour of iodine, or bromine, or the two combined, or either of them combined with chlorine; or the copper is dipped into a solution of some of these substances in alcohol, ether, &c. On this copper a photogenic image is formed in the usual manner, and exposed to the vapour of sulphuretted hydrogen, when a different colour is produced on those parts of the copper which have been acted upon by the light to that which appears on the parts not so exposed; consequently, a permanent coloured photogenic image is obtained, which is not injured by further exposure to light. A fourth improvement is as follows:—A thin coating of silver is given to a plate of steel or other suitable metal, which is made sensitive to light in the usual way; the plate is then placed horizontally and covered with a solution of acetate of lead, through which a galvanic current being made to pass a coloured film is precipitated on the picture. A fifth improvement consists in a method of obtaining very thin surfaces of silver for photographic processes. A very thin plate of copper is first precipitated on a polished plate of metal by the electrotype process, and a sheet of card is cemented to the back of the layer; when dry, the card and copper are removed, and the copper silvered by immersion in a suitable solution of that metal. A sixth and last improvement is in transferring photogenic pictures from paper to metal. For this purpose, the surface is rendered sensitive to light, and the picture placed upon it with a plate of glass in front, kept in contact by screws, and exposed to the sun's rays, when the required transfer is effected; which is to be afterwards fixed, and otherwise treated according to the effect required.—*Mech. Mag.*

RAILWAY SIGNALS.

Abstract of a patent granted to Charles Hood, of Earl Street, Blackfriars, for improvements in signals. Enrolment Office, August 1, 1841.—A suitable receiver is filled with air condensed to about 45 lb. per square inch, by means of a condensing syringe; this receiver is provided with a tube to which a whistle is attached, similar to the steam whistle of locomotive engines, but rather smaller. A stop-cock is placed upon the tube, between the whistle and the receiver, on turning of which the condensed air passes through, and sounds the whistle. This contrivance enables the guard of a railway train to give a signal to the engine-driver, in case of accident of any kind. It is also applicable to steam boats, or to railway stations, for giving signals at night, or in foggy weather. A second signal apparatus consists of four wedge-shaped leaves or panels, which are centred at their pointed ends, describing an arc of 45°, and spreading out like a fan. These leaves are attached to each other in such a manner, that on pulling a cord, the lowest leaf is drawn up behind the second, the second leaf behind the third, and all three behind the fourth; lastly, the four are drawn up into a case, by which they are concealed. Each leaf is painted a different colour, indicating some arbitrary sign. The raising or lowering of these fan-like leaves may be done by hand, or by means of machinery. For night signals, each leaf has a pane of glass let into it, on which figures, &c., may be painted, to indicate fixed intervals of time, when worked by clock machinery. On an engine-driver approaching one of these signal stations, the colour or number of the leaf that is visible will convey the intelligence desired—to stop, to proceed cautiously, or any other signal. If no leaf is visible, no signal is to be communicated, and he will fearlessly continue his progress. The claim is—1. To the mode of giving signals by applying condensed air in apparatus, in combination with whistles. 2. To the mode of giving telegraphic signals on railways, by means of moveable leaves or panels, worked either by hand or by machinery, or by both means conjointly, and combining therewith clock movements, or other similar machinery, for producing a gradual and ascertained velocity of motion in the leaves or panels of the telegraph, and for the continuous sounding of an alarm bell, as described.—*Ibid.*

RAILWAY TURN TABLE.

Abstract of a patent granted to Elisha Oldham, of Cricklade, Wilts, railroad contractor, for certain improvements in the construction of turning-tables to be used on railways. Petty Bag Office, August 8, 1841.—The upper platform of the table is composed of a strong iron framing, filled in with wood, and supported at its centre upon an upright pin or pivot, lubricated by means of an oil-chamber immediately over it. At the extreme edge, or at a point nearer to the centre, the platform is supported upon eight iron anti-friction rollers, mounted in bearings upon a stationary cast iron framing. The whole weight of the carriage, &c., rests entirely upon the centre pin, when the platform is properly balanced; but if the weight is unequally placed, one side of the platform will be sustained by the anti-friction rollers. The claim is to the arrangement of parts herein described, as applied to the construction of turn-tables; or any other arrangement in which the moveable platform is supported on a pin or pivot at its centre, and assisted by stationary anti-friction rollers at its sides, in the manner described.—*Ibid.*

DREDGING MACHINE.

Abstract of an American patent granted for improvements in the Dredging Machine, for deepening Harbours, Rivers, Canals, &c., to William Easby, City of Washington, D. C. August 25, 1841.

This machine is intended to be worked by horses, that travel on a circular platform, built on the deck of a large scow. The whole machine is made narrow enough to pass through a canal lock, and in order to make the platform, on which the horses travel, of sufficient size, a segment of the circle, called a wing, is hinged on each side to the scow, so that in passing through a canal lock, or any other narrow place, the wings may be turned up. The scoop is to be worked by two barrels, or drums, placed one at the top, and the other at the bottom, of a vertical shaft, in the middle of the platform—these drums are, alternately, thrown in and out of gear by means of a vertical sliding bolt, and a horizontal lever, worked by the attendant. The chain that draws up the scoop passes around a roller at the end of the machine, and thence around the barrel at the top of the shaft, and that which draws it down and back, passes under the platform, and winds on the lower barrel.

The scoop is attached by one of its sides to two long guide poles, that slide in loops made in two collars, turning loosely on the ends of a horizontal windlass, which forms the axis around which the scoop swings, when drawn up or let down. In letting down the scoop, the chain which is attached to its bottom, is drawn in by throwing the lower barrel into gear; this causes the guide poles of the scoop to slide in the loops, which brings it near to the windlass, and after it has passed a vertical line its gravity causes it to sink. The lower barrel is then thrown out of, and the upper into gear; by this the scoop is drawn along the bottom, and filled, and then, with its load, is drawn up out of water. The stuff raised is discharged from it into a scow, or other receptacle, by pulling a rope, or chain, which disengages a spring catch, by which the hinged bottom is fastened. The bottom is closed as the scoop strikes the water, in the operation of being drawn down to be re-filled. The distance to which the scoop descends below the windlass, around which it works, is regulated by a chain, which winds around it, and is attached to a brace connecting the two guide poles together, near the scoop.

Claim—"What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the barrels on the perpendicular shaft, for winding and unwinding the main chains, in combination with the vertical sliding bolt and lever, for throwing the barrels in, and out of gear, with the shaft, by which the scoop, or bucket, is alternately raised, lowered, and drawn back, whilst the animal, by which the main shaft is turned, continues to travel on the circular tracks without interruption." Also the combination and arrangement of the parallel guide poles, chains, and windlass, for raising the scoop, so as to draw it back to its proper position, as described; and this I also claim in combination with the scoop and the apparatus for "disengaging the drop, or shutter, to discharge the load, as described." I also claim "the arrangement of the wings of the horse track, which can be raised, and thereby reduce the width of the machine, so that it may pass through a canal lock, or any other narrow place, as described."—*Franklin Journal.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

J[illegible].—The President in the Chair.

The following were elected: John Ball and Adalbert Morawski (of the Grand Duchy of Posen), as Associates.

"*Description of Stephenson's Theatre Machinery.*" By J. B. Birch, Grad. Inst. C. E.

In this communication the author describes a system of machinery which was erected for the purpose of avoiding the confusion, mistakes, and noise, consequent upon the number of men usually employed in the stage department of a theatre, and with a reduced number of men to effect more perfectly all the operations required there.

The apparatus provides means for shifting simultaneously and without noise, any number of distinct pieces of scenery, bringing at the same time into view other scenes to replace them. The general arrangement of the machinery for effecting this is fully described.

The interior of the house between the basement and the roof, is divided into four compartments, viz.:

1. A raised platform on which the gearing for working the stage traps is placed. The trap frames are mounted upon rollers: they traverse on the lower platform in every direction; and when brought under the apertures in the stage, allow the traps to sink or rise steadily at any required speed.

2. The stage, with its traps of various dimensions, including a considerable portion formed to rise or fall by suitable machinery, and called the sinking stage.

3. The lower flies or corridor, between which and the stage are placed the wings or side scenes, and the border frames are suspended.

4. The upper flies upon which is placed the machinery to communicate motion to the whole, from the upper horizontal shaft, by means of bevel gear, provided with double clutches to reverse the motion and shafts, on the lower ends of which are the slow-motion wheels and drums, an endless chain is driven horizontally in either direction; to this are attached the borders representing clouds, foliage, arches, &c.

The side scenes or wing frames, the number of which is determined by the depth of the stage, may be either flat, circular, or triangular, and receive a rotary motion, combined with or apart from a forward and backward movement at pleasure, and can be placed at any desired angle to the audience. At every change of the scene they revolve through 120° or ⅓ of a circle, and the scenes when removed from sight are replaced by those which are to succeed them. The traversing frames revolve on a centre, and are suspended from the border frames, or from the upper part of the theatre, for crossing the stage in any direction, and at any given inclination. Several improvements in the mode of lighting the stage and house have been introduced with the machinery; they are more fully referred to in the detailed description which accompanies the ten elaborate drawings sent with this communication.

"*On the Combustion of Anthracite, and its value as a Fuel for Steam Engine and other Furnaces.*" By Andrew Fyfe, M.D.

Anthracite, although known as a valuable fuel for particular purposes, is so difficult of combustion, that it has hitherto been very partially brought into use; it has, however, become desirable to introduce it more generally, and the author having been engaged in testing the value of Mr. Bell's patent furnace, was induced to make some experiments on the use of anthracite in conjunction with that system.

The objects sought to be obtained by the apparatus are, to insure a larger amount of evaporation, by passing heated air, unmixed with the products of combustion, through tubes in the boiler and surrounded by the water, thus increasing the evaporating surface; and that the surplus caloric taken originally from the fuel, and not given out in its passage through the water, should be beneficially used in aiding the combustion beneath the boiler.

It has been found in the manufacture of iron that anthracite could be advantageously used by means of heated air; the author therefore considered that the experiments upon this apparatus (the intrinsic merits of which he does not at all discuss in this communication), afforded an advantageous opportunity for ascertaining in what manner this fuel could be successfully employed under steam boilers.

The anthracite supplied to the author was unfortunately of inferior quality, analysis giving only of fixed carbon 71·1, and of volatile inflammable matter 13·3; the setting of the boiler required much alteration before sufficient draught could be procured. The fuel was thrown on to the bars by hand, which is the worst manner of using it, as from its density, and its being a bad conductor of heat, it decrepitates when it first inflames, unless it is previously warmed—this was found to occur for a short time, but on the application of the heated air the decrepitation ceased, and combustion went on steadily. In ascertaining the amount of evaporation, the water at a temperature of 45° was injected by hand from a vessel, the content of which was measured, and the level in the boiler regulated by the float and index. The fire was brought up to a certain intensity before commencing, and was left in the same state at the end of the experiment; this mode of proceeding, although objectionable with bituminous coal, is not so with anthracite, as it does not swell during combustion so as to alter the bulk of the fire.

Results of the experiment.—The results of an experiment extending over [illegible] hours without interruption, are then shown in a tabular form. In this trial, 448 lb. of anthracite were thrown on the fire in four equal portions, at intervals of two hours; 3560 lb. of water at 45° were pumped into the boiler and evaporated under a pressure of 17 lb. per square inch. After deducting 40½ lb. of unconsumed coal which fell through the bars, the amount of evaporation was found to be 8·73 lb. of water for each pound of coal consumed. If the feed water had been at a temperature of 212° the evaporation would have amounted to 10·03 lb. During this trial the air in the tubes of the boiler never exceeded 139°, but on subsequent occasions it was raised as high as 700°.

This product of evaporation is below that obtained by other persons, which the author attributes to the inferior quality of the specimens of anthracite, and the admission of cold air above the furnace bars when throwing on the fuel. His opinion is, that when anthracite is completely burned, the practical evaporative power will be found directly in proportion to the amount of fixed carbon contained by it—that with the exception of the loss of heat which is always transmitted to the brick-work of the furnace, and of that which is carried up the chimney to keep up the draught, the whole of that evolved by the fixed carbon will be retained by the water; because from good fuel there is little or no escape of gaseous matter, and hence the superior efficacy of anthracite. From the analysis of a number of specimens of anthracite, the author found the quantity of fixed carbon to amount to 90 per cent. The evaporative power of these fuels, as fixed by Berthier's process (la voie sèche), would amount to 12·3 lb. of water for each pound of coal consumed. He calculates that 6 lb. of anthracite will evaporate one cubic foot of water under the ordinary circumstances of a steam engine boiler, and taking the average specific gravity of bituminous fuel at 1280, while that of anthracite is 1410, there is a difference of nearly 10 per cent. in favour of the latter, considering the space in which it can be stowed. This is an important consideration for its use on board steam vessels, but it is essential that its rate of combustion should be such as to raise steam rapidly, its capabilities for which the author then proceeds to examine, and deduces from the experiments that the combustion of the anthracite was carried on so as to produce a greater amount of evaporation in a given time, than could be obtained from bituminous coal. This result is attributed in some degree to the use of heated air.

The author recommends that the anthracite should be supplied to the furnace by a hopper through the boiler,* wherein it is warmed before reaching the fire bars, which obviates the inconvenience of decrepitation, and insures regularity in the supply of steam.

Mr. Lowe saw no reason to doubt the results recorded by so accurate an experimenter as Dr. Fyfe, which proved that anthracite was efficient just in the proportion of the carbon it contained, but he was at a loss to reconcile this with the opinion of Mr. C. W. Williams, who recommended the addition of bituminous substances to pure carbon, as a means of increasing the calorific power of fuel. He must repeat the opinion expressed by him on a former occasion, that the coal most free from elementary oxygen, would in practice be found the most effective fuel. Neither could any fuel be used too dry or too hot. At the gas works under his charge, a considerable economy had been effected by Mr. Croll's patent process of using the coke as it was drawn from the retorts, and thrown in an incandescent state into the furnaces.

June 15.—The President in the Chair.

The following were elected:—Daniel Pinkney Hewett and John Boustead as Graduates; and Gerrit Simons (of the Hague) as an Associate.

"*Description of the new Sewer in the Valley of the Cowgate, Edinburgh.*" By George Smith.

In this communication the author first gives an account of a complete system of drainage, designed by him as architect to the Commissioners for improving the City of Edinburgh, and then describes the mode of constructing the first sewer, which begins at the south back of the Canongate, passes along the Cowgate, and through the Grass-market to the foot of the Bow. This principal sewer is 950 feet long; it was built in several sections; the upper portion was 4 feet high by 2 feet 6 inches wide, and increased at the lower extremity to 5 feet high by 3 feet wide; it was constructed of stone with vertical sides, and large flat stones for both the sills and the covers—the dimensions of the branch drains varied in proportion to the quantity of matter passing through them; they were situated opposite the cross streets, and had a cesspool to each, with a malleable iron grating hinged to afford access for cleansing them. The average depth of the excavations was 9 feet; a great portion of the work demanded great precaution in executing, on account of the narrowness of the streets, the frequent floods, the local impediments from the gas pipes, &c., and the soft character of the ground, as in some places the foundation stones sunk deep into the mossy soil by their own weight; it has, however, proved very successful, and will doubtless induce an extension of the sewage of the City of Edinburgh, which has been too long neglected.

The paper was accompanied by two drawings of the construction of the sewers, and the plan of the general system proposed, with the report to the Commissioners and other explanatory documents.

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* Player's Patent.

"*On an uniform System of Screw Thread.*" By Joseph Whitworth, Assoc. Inst. C. E.

The subject considered in this paper, is the importance of having a constant thread for a given diameter in all screws used in fitting up steam engines and other machinery. It is argued, that uniformity of thread would be productive of economy, both in the use of screwing apparatus, and in the consumption of bolts and nuts. The refitting shop of a railway or steam packet company affords a striking instance of the advantage to be derived from the application of this principle. If the same system of screw threads were common to the different engines, a single set of screwing tackle would suffice for any repairs. No attempt appears to have been hitherto made to attain this important object. Engineers have adopted their threads without reference to a common standard. Any such standard must be in a great measure arbitrary, and hence its absence may be accounted for.

The author enters at some length into the consideration of the circumstances affecting the choice of a thread, with a view to show that it cannot be determined by precise rules. The essential characters of the screw thread are—pitch, depth, and form. The required conditions are—power, strength, and durability. But the exact degree or proportion in which these conditions are required, cannot be ascertained, and consequently the characters on which they depend cannot be fixed by calculation. An approximation may be made, but within a certain limit the decision is arbitrary. The mutual dependence of the several conditions, and the relation subsisting between the constituent characters, are noticed as having a tendency to perplex in the choice of a thread. From the vagueness of the principles involved in the subject, a corresponding latitude was naturally to be expected in the practical application of them, and accordingly, instead of that uniformity which is so desirable, there prevails a diversity so great as almost to discourage any hope of its removal. The only mode in which this could be effected, would be by a compromise; all parties consenting to adopt a medium for the sake of common advantage. The average pitch and depth of the various threads used by the leading engineers, would thus become the common standard, which would not only have the advantage of conciliating general concurrence, but would in all probability approach very nearly to the true standard for practical purposes.

The author then proceeds to describe the mode adopted by Messrs. Whitworth and Co., some years since, in selecting their threads upon this principle. An extensive collection was made of screw-bolts from the principal workshops throughout England, and the average thread was carefully observed for different diameters. The $\frac{1}{4}$ inch, $\frac{1}{2}$ inch, and $1\frac{1}{2}$ inch, were particularly selected, and taken as the fixed points of a scale by which the intermediate sizes were regulated, avoiding small fractional parts in the number of threads to the inch. The scale was afterwards extended to 6 inches. The pitches thus obtained for angular threads were the following:—

Diameter in inches.	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1″	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2″
No. of threads to the inch.	20	18	16	14	12	11	10	9	8	7	7	6	6	5	5	$4\frac{1}{2}$	$4\frac{1}{2}$

Diameter in inches.	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3″	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	4″	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	5″	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6″
No. of threads to the inch.	4	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{4}$	3	3	$2\frac{7}{8}$	$2\frac{7}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{5}{8}$	$2\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{1}{2}$

Above the diameter of 1 inch the same pitch is used for two sizes, to avoid small fractional parts. The proportion between the pitch and the diameter varies throughout the entire scale. Thus the pitch of the $\frac{1}{4}$ inch screw is $\frac{1}{5}$ of the diameter; that of the $\frac{1}{2}$ inch $\frac{1}{6}$, of the 1 inch $\frac{1}{8}$, of the 4 inches $\frac{1}{12}$, and of the 6 inches $\frac{1}{15}$. The depth of the thread in the various specimens is then alluded to. In this respect the variation was greater than in the pitch. The angle made by the sides of the thread being taken as an expression for the depth, the mean of the angle in 1 inch screws was found to be about 55°, which was also nearly the mean in screws of different diameter. Hence it was adopted throughout the scale, and a constant proportion was thus established between the depth and the pitch of the thread. In calculating the former a deduction must be made for the quantity rounded off, amounting to $\frac{1}{3}$ of the whole depth, *i. e.* $\frac{1}{6}$ from the top, and $\frac{1}{6}$ from the bottom of the thread. Making this deduction, the angle of 55° gives for the actual depth rather more than $\frac{3}{5}$, and less than $\frac{2}{3}$ of the pitch.

It is observed that the system of threads thus selected has already been widely extended, demonstrating the practicability and advantage of the proposed plan. The author then notices the obstacles to general uniformity arising from the inconvenience which any change would occasion, in existing establishments, and also from the imperfect screwing tackle in general use. He anticipates as an important result of a combined effort to introduce uniformity, that screwing tackle generally would be much improved, and the efficiency and economy of bolts and nuts be thereby increased.

He recommends also standard gauges of the diameters and threads, as they would form a convenient adjunct to the screwing apparatus, and would be applicable to other useful purposes.

Mr. Field claimed for the late Mr. Maudslay the credit of the first attempt to introduce uniformity of thread—it was well known how incessantly his attention and skill had been devoted to this object, and with what success his efforts had been attended. He would at the same time accord great merit to Mr. Whitworth, not only for his present effort to introduce a very desirable measure, but also for the general excellency of the screwing tackle made under his directions.

Mr. Seaward corroborated all that Mr. Field had advanced; he had always considered that to Mr. Maudslay the mechanical world was indebted for the accuracy with which screws were now made. He considered the plan proposed by Mr. Whitworth to be good, but difficult of attainment in old-established manufactories, where very extensive assortments of screwing tackle already existed.

The President concurred in the opinion, that it was to Mr. Maudslay's well-known talent and skill that the mechanical world was indebted for the great improvements in the form of the screw, and the mode of its manufacture; but it was to Mr. Whitworth that the Institution was indebted for having brought the subject before the meeting; he trusted that this example would not be lost upon the numerous members, who could contribute so largely to the interests of the meetings, by recording the facts which came under their notice in the course of their diurnal employments.

"*Account of the original construction and present state of the Plymouth Breakwater.*" By William Stuart, M. Inst. C. E.

In the year 1806, the Lords Commissioners of the Admiralty instructed the late Mr. John Rennie, C. E., and Mr. Whidby, then Master-Attendant at Woolwich Dock, to make a survey of Plymouth Sound, with a view to the construction of a breakwater for sheltering vessels.

Their report was favourably received, but it was not until 1812 that the works were commenced.

Their plan consisted of a pier or breakwater 1700 yards in length, the centre part of which, 1000 yards long, was straight, with an extension at each end 350 yards in length, placed at an angle of 20° with the main body. The top to be 30 feet wide at the level of 10 feet above the low water of an ordinary spring tide:—the slope towards the sea to be 3 feet horizontal to 1 foot perpendicular, and on the land side 1 foot 6 inches horizontal to 1 foot perpendicular.

By the middle of March, 1813, the work had been brought up in parts to within 5 feet of low-water mark of spring tides—at this period 43,789 tons of stone had been deposited—and in the month of March of the following year sufficient shelter was afforded for ships of war to anchor in the Sound instead of in Cawsand Bay.

It was then determined to raise the whole structure to the height of 20 feet above low-water spring tides; great exertions were made to complete it rapidly, and during the week ending on the 24th of May, 1816, the quantity of stone deposited amounted to 15,329 tons, which was the largest quantity ever conveyed within the same space of time.

Slight injury had frequently been received by the works whilst in progress, but the storm of the night of the 19th of January, 1817, was the first which materially affected them. The most destructive effects were, however, produced by the storm of the 22nd and 23rd of November, 1824. On that occasion the spring-tide rose 7 feet higher than usual; and so great was its power, that a length of 795 yards of finished work was completely overturned, and the remaining parts slightly injured.

It was observed, that the effects of this storm left the slope from low-water mark upward at about 5 feet horizontal to 1 foot vertical. It was therefore determined to adopt that angle of inclination for the exterior or sea side, and a slope of 2 to 1 for the inside. The centre line of the breakwater was also removed 19 feet 6 inches towards the north, and the top width was increased to 45 feet.

The works continued upon this scale until 1830, when a fore-shore was added of a width of 50 feet at the toe of the south slope at the west end, and of 30 feet at the east end of the main arm: for this purpose 600,000 tons of stone were deposited.

The extreme western end of the breakwater was then, after more alterations and extensions, terminated by a circular head, with an inverted arch as a foundation for a light-house, now constructing under the direction of Messrs. Walker and Burges.

In consequence of further injuries from storms in 1838, when large quantities of stones of 16 or 20 tons' weight each were torn from below low water, and carried completely over the top of the Breakwater, a further extension of the fore-shore was made, and a projecting buttress built to secure the foot of the south slope, to afford additional security to the light-house, and to prevent the stones from the fore-shore being carried over to the north side.

From the time of its commencement in August, 1812, until the 31st of March, 1841, there had been deposited upon this work 3,369,261 tons of stone.

Cost.—The expenditure upon the whole work, when completed, will, it is estimated, be within one million and a half sterling. The main body of the work is composed of blocks of limestone from the quarries of Oreston, adjoining the harbour of Catwater. They were deposited from vessels constructed for the purpose. In certain portions of the work the blocks have been subsequently ranged from a diving bell. The buttress and the works now in progress round the west end are composed of granite masonry, dove-tailed horizontally, and fixed vertically by iron levis cramps.

Subsequently to the reception of the plan of Messrs. Rennie and Whidby, most of the leading engineers of the day were consulted, under whose directions the author has superintended the execution of the work.

The communication is accompanied by six elaborate drawings by Mr. Dobson, illustrating in detail the various stages of the work, and the mode of construction.

Mr. Rendel could have wished that the account of this interesting work, the most extensive of the kind in Great Britain, had entered more fully into details, not only of the difficulties met with and overcome, but of the peculiarities of the construction; there were many points connected with it of great importance to engineers. He would allude to one only upon which no information was given; the amount of interstice in the whole cubic content as compared with the mass of materials employed; an accurate account had been kept of the quantity of stone deposited, and knowing the cube of the mass at a given period, he had ascertained the amount of interstice or vacant space in the old part of the works to be at one time 37 per cent. This great deficiency of solidity had arisen from the employment of an excess of large stone, or rather from a deficiency of small stone to fill the interstices between the large stones.

June 22.—The PRESIDENT in the Chair.

The following were elected: Joseph Colthurst, as a Graduate; Colonel George Ritso Jervis, B. E., Captain Henry Goodwyn, B. E., and William Lamb Arrowsmith, as Associates.

"*On the Construction and Use of Geological Models in connexion with Civil Engineering.*" By Thomas Sopwith, F. G. S., M. Inst. C. E.

The author commences this paper with a review of the various methods adopted for the representation of objects required in carrying out the designs of engineers, architects, and mechanics—whether as the means whereby such designs are first studied, and afterwards matured—as guides for the resident superintendents and workmen—or for being preserved as records of what has been executed, and studies for those who may be engaged in similar undertakings.

He then proceeds to elucidate the advantages peculiarly possessed by models for demonstrating practical results in Geology and Mining, dividing the subject into six heads, as follows:

1. On the application of modelling to geological and mining purposes.
2. On the materials to be employed.
3. On the mode of construction.
4. On the scales to be employed.
5. On the objects to be represented.
6. On the use of geological models, and the connexion of the subject with civil engineering.

1. A large number of plans and sections is usually required to elucidate with clearness the geology of a district, and the nature and extent of mining operations; and few departments of practical science admit of greater improvement than the art of delineating mining plans in connexion with geological features.

Much ingenuity has been exercised in representing the undulating surface of countries either by the process called "relief-engraving, (procédé Collas) or as in the Ordnance Maps of England and Wales, and Mr. Greenough's recent edition of his Geological Map: but even in comparison with these a model affords a more correct idea. Hence models in relief are more peculiarly applicable in all cases where it is desirable to comprehend at once the relations of the several parts, and it is evidently still better adapted to explain the geological conditions; especially when it is required to show the relative position of various rocks, their inclination, thickness, extent, and the disturbances to which they have been subjected, which could only be understood by comparing together a number of drawings.

To those interested in mining, therefore, the easiest mode of conveying ideas is by modelling. This was illustrated by two models of the Forest of Dean, and by reference to Mr. Jordan's model of the Dolcoath mine, now in the Museum of Economic Geology.

Materials for models.—2. The first material for forming a model which naturally occurs to the mind is clay, pins and wires being used to define the principal elevations. Plaster of Paris has occasionally been used, and is well adapted for solid forms, where the edges are not exposed to injury; but its brittleness and contraction in drying are objectionable. Papier Mâché is a more elegant and durable material, but the expense of the requisite moulds prevents its general use. Coloured wax is adapted for small models not subject to be handled. Pottery appears to possess more requisites, but many corresponding disadvantages. Of all the materials which the author has employed, he found none so generally useful as well-seasoned wood, whether for the facility with which the requisite forms are attained, for durability, for portraying different strata by various-coloured woods, or for comparative economy.

Mode of construction.—3. The mode of constructing geological models had been briefly alluded to by the author on a preceding occasion.* It is more fully described in the present communication, and was illustrated by complete models, and the detached parts for forming them purposely made on a large scale.

The plan of the district being divided by lines at given distances apart, into a certain number of squares, a series of thin slips of wood are made to intersect each other, corresponding to the lines so drawn—upon these slips the profile of the surface and the positions of the strata are delineated, when it is intended that the model when complete shall be dissected; the compartments are then filled in with wood, and carved down to the lines upon the slips, the several strata thus rest upon the subordinate beds, and can be detached in a mass or in compartments; these being geologically coloured, convey an accurate idea of the relative positions of the strata, and display with the utmost clearness the mining operations in each. This system is applicable to any extent: and the operation of forming the model is so simple, that a skilful workman at once comprehends and executes unerringly the instructions given him by the engineer or surveyor, as the accuracy entirely depends upon the profile which is drawn upon the slips. The author considers lime-tree or plane to be the most suitable wood for the purpose; but in the construction of small models for showing peculiar geological features or disturbances of strata, he uses various coloured woods: as an illustration of which he showed a series of twelve models, which (with a printed description*) are now in the Museum of the Institution. These contain 579 pieces of wood, one of them consisting of 130 pieces. By fitting the parallel layers of wood together, and arranging them in conformity with sections of strata of the carboniferous limestones and coal measures of the north of England, he illustrates the formation of that district, and the nature of its dislocations, &c. better than can be done by any number of plans and sections.

4. *Scales to be employed.*—Attention is drawn at some length to the proportion to be observed between the horizontal and vertical scales, and the relative merits of corresponding and dissimilar horizontal and vertical scales fully examined, illustrating the positions by two models of the Forest of Dean, in one of which the vertical is enlarged to three times that of the horizontal scale; while the other has the scales exactly alike. For the conventional purpose of giving an idea of a country such as would be formed by a general observer passing through it, the former model appeared best adapted; but in a scientific point of view the latter had a decided advantage, being based on geometrical truth, and conveying an exact knowledge of the real, but not of the apparent relations of the surfaces, and other objects represented.

5. *Objects to be represented.*—Models had hitherto been chiefly used for conveying impressions of tracts of the surfaces of countries, or for displaying the minute tracery and proportions of buildings. The author's views have been more especially directed to introducing the construction of models for geological and mining purposes, for which he considers them peculiarly adapted.

The series of models now presented to the Institution, contains examples of various geological phenomena of regular stratification—interruption by slips, faults, and dykes—the effects of denudations in exposing to view the various strata—the deceptive appearance of the course of mineral veins on the surface—the intersection of veins—and many other details which are intimately connected with practical mining.

6. *Models used in civil engineering.*—The author then proceeds to describe his view of the uses of such models, and the connexion of the subject with civil engineering.

He considers that by them a practical knowledge of geology may be attained by the civil engineer, and that such knowledge is indispensable for his guidance in many of the works he is called upon to undertake in the exercise of his profession. It is to an engineer that the merit is justly due of having, by efficiently labouring to establish English geology on a firm basis, acquired the title of "Father of Geology," which has been generally conceded to the late Mr. William Smith.

The avocations of the civil engineer peculiarly qualify him for an observant geologist; and being called upon to visit so many different districts, the remarks he might make would be replete with instruction. These observations might be illustrated more efficiently by models than by any other means; at the same time they might be made to answer another purpose—that of demonstrating to the owners of mineral property the advantage or the futility of commencing researches or mining speculations.

Plans do not admit of such certainty of definition as modelling, and no regular system of planning mining districts has yet been generally practised, by which the engineer can judge of the probable results of the operations which he is often called upon to direct. As a record of mining operations, models of this kind are pre-eminently valuable; the exact position not only of the mineral veins and the strata are clearly shown, but the quantities extracted are registered, and a guide for future proceedings is established. The author contends that it is a duty to secure, while it is in our power, such records of mining operations as may enable us and our successors really to exhaust whatever minerals can be worked with advantage.

As being in some degree connected with the subject under discussion, Dr. Buckland described a mode used by Sir John Robison, for obtaining moulds for plaster casts. The object, of which the mould was required, was immersed in a mixture of common glue, dissolved in brewers' sweet wort of about the consistency of thick cream, and allowed to remain until the mass became

* Journal, Vol. III., page 347.

* Description of a series of Geological Models, &c. By Thos. Sopwith, F.G.S., &c. 12mo. Newcastle, 1841.

stiff: it was then released by cutting the mould open, when it would be found to resume its original form like Indian rubber: holes were made in it for pouring in the plaster of Paris, and for carrying off the air; from such moulds, casts of the most delicate objects could be taken.

He entirely concurred in the praise of the beauty and the utility of the models which had been described, and he hailed with much pleasure the co-operation of engineers in the study of geology; by their researches in the science of dynamics, and their knowledge of the power of elastic vapours, light might be thrown upon the upheavings of the great mountain ranges; whether that had been the work of time, or by the sudden development of a mighty force, it was peculiarly the province of the civil engineer and the mathematician to consider and to explain. The observation of the effects of torrents, the causes of removal of masses of material, the disturbance of strata in certain localities, and numerous other instances of the utmost interest to the geologist, were even more important to engineers.

Mining models.—In mining operations, where for want of accurate records of previous workings, much expense was frequently incurred, accompanied with loss of human life, the adoption of the models proposed by Mr. Sopwith was of the utmost importance; he trusted that the keeping of such records of present operations would be rendered compulsory by legislative enactment, that proprietors of collieries would not be permitted by inattention to do irremediable injury to the mineral and coal basins, which were the vital riches of the country. If accurate models of all the coal districts were prepared, similar to that of the Forest of Dean, a close estimate of the duration of the supply of mineral fuel could be made: present expense would also be avoided, by the best positions for sinking pits and erecting engines for draining being fixed upon with greater certainty, the positions and extent of the beds or veins of coal or minerals, the faults, dykes, slips, &c., would be shown for the guidance of speculators; in fact, these models would do much towards giving a degree of precision to a branch of engineering, in which the greatest uncertainty prevailed at present.

Thames Tunnel borings.—As an instance of the utility of a knowledge of geology to the engineer, he might mention, that after the Thames Tunnel had been commenced by Sir Isambard Brunel, upon an assurance from those who made the borings that they had reached the London clay, it was found that they were actually traversing the sands of the plastic clay; hence arose nearly all the difficulties which the engineer had displayed so much skill and perseverance in overcoming.

Artesian well at Paris.—It was the adaptation of the science of geology to engineering, which enabled Monsieur Arago to inspire the contractor for the Artesian Well of the Abattoir de Grenelle, with the confidence that he should eventually obtain the abundant supply of water which had from the commencement been foretold—and which had now been realised.

In short, whether viewed in connexion with the labours of the mining engineer as directing his proceedings with greater certainty, or giving a correct knowledge of the properties of materials employed in the works of the civil engineer, and for numerous other self-evident reasons, he considered the study of geology to be indispensable for every member of the profession.

The Council of the Institution of Civil Engineers have awarded the following Telford and Walker premiums for 1841:—

A Telford Medal in Silver to John Frederick Bateman, M. Inst. C. E., for his "Account of the Bann Reservoirs, County Down, Ireland."

A Telford Premium of Books, suitably bound and inscribed, to William La Trobe Bateman, for the Drawings illustrating the "Account of the Bann Reservoirs."

A Telford Medal in Silver to Samuel Seaward, M. Inst. C. E., for his Paper "On the application of Auxiliary Steam Power to Sailing Vessels upon long voyages."

A Telford Medal in Silver to Benjamin Green, for his "Description of the Arched Timber Viaducts on the Newcastle and North Shields Railway, &c."

A Telford Medal in Silver to Thomas Sopwith, M. Inst. C. E., for his Paper upon "The construction and use of Geological Models in connexion with Civil Engineering."

A Telford Medal in Silver to Dr. Charles Schafhaeutl for his two Papers on "A new Universal Photometer," of his invention, and "On the circumstances under which the Explosions of Steam Boilers frequently occur."

A Telford Premium of Books, suitably bound and inscribed, to David Stevenson (Edinburgh), for his "Description of a Coffer Dam, designed by him for Excavating Rock in the Navigable Channel of the River Ribble."

A Walker Premium of Books, suitably bound and inscribed, to George Clarisse Dobson, Assoc. Inst. C. E., for the execution of the Drawings illustrating the "Account of the Plymouth Breakwater, by William Stuart, M. Inst. C. E."

A Walker Premium of Books, suitably bound and inscribed, to Robert Mallet, Assoc. Inst. C. E., for his "Description of the methods designed by him for raising and sustaining the Sunken Roof of St. George's Church, Dublin."

A Walker Premium of Books, suitably bound and inscribed, to Joseph Colthurst, Grad. Inst. C. E., for his two Papers "On the Position of the Neutral Axis in Rectangular Beams of Cast and Wrought Iron and Wood," and "Experiments on the Force necessary to Punch Holes in Wrought Iron and Copper Plates of various thickness."

A Walker Premium of Books, suitably bound and inscribed, to George Thomas Page, Assoc. Inst. C. E., for the Drawings illustrating the "Memoir of the Montrose Suspension Bridge, by James Meadows Rendel, M. Inst. C.E."

A Walker Premium of Books, suitably bound and inscribed, to Samuel Clegg, jun., for his "Description and Drawings of the Great Aqueduct at Lisbon, over the Valley of Alcantara."

A Walker Premium of Books, suitably bound and inscribed, to John Brannis Birch, Grad. Inst. C. E., for the "Description and Drawings of Stephenson's Theatrical Machinery."

The Council invite communications on the following as well as other subjects for Telford and Walker premiums:—

1. The alterations and improvements in Blackfriars Bridge.
2. A Description of the Katwyk Dykes; the Canal of the Helder; or of any similar Foreign Engineering works of equal importance.
3. The modes of Drainage adopted in the Lowlands of the United Kingdom, or works of a similar nature in Holland or in other countries.
4. On any of the principal Rivers of the United Kingdom: describing their Physical Characteristics, and the Engineering works upon them.
5. The various kinds of Limes and Cements employed in Engineering Works.
6. The resistance to Aeriform Fluids in their passage through Pipes or Conduits at different velocities.
7. The conveyance of Fluids in Pipes, under Pressure, and the circumstances which usually affect the velocity of their currents.
8. The means of rendering large Supplies of Water available for the purpose of extinguishing Fires.
9. The construction of large Chimneys, as affecting their Draught; with examples and drawings.
10. The comparative advantages of Wire and Hempen Ropes.
11. The relative merits of Granite and Wood Pavements, derived from actual experience.
12. The ascertained effects of any method for preserving Timber from decay.
13. The Smelting and Manufacture of Iron, either with Hot or Cold Blast.
14. The Smelting and Manufacture of Copper.
15. The comparative advantages of Iron and Wood, or of both materials combined, as employed in the construction of Steam Vessels: with drawings and descriptions.
16. The sizes of Steam Vessels of all classes, whether River or Sea-going, in comparison with their Engine Power: giving the principal dimensions of the engines and vessels, draught of water, tonnage, speed, consumption of fuel, &c.
17. The various mechanism for propelling Vessels, in actual or past use.
18. The causes, means of preventing, and methods of determining the amount of priming in Steam Boilers.
19. The description of any Meter in practical use for accurately registering the quantity of Water for supplying Steam Boilers, or for other purposes.
20. The explosion of Steam Boilers; especially a record of facts and evidence connected with any well-authenticated cases; also a description, drawings, and details of the Boilers, both before and after the explosion.
21. The various modes adopted for moving Earth in Railway Tunnels, Cuttings, or Embankments, with the cost thereof.
22. On Stone Blocks and Timber Sleepers or Sills, with or without continuous Bearings, for Railways.
23. The results of experience as regards the consumption of Power for a given effect, on Railways having different widths of Gauge with the advantages or disadvantages attributable to any established width of Gauge.
24. Memoirs, and Accounts of the Works and Inventions of any of the following Engineers:—Sir Hugh Middleton; Arthur Woolf; Jonathan Hornblower; Richard Trevithick; and William Murdoch (of Soho).

The communications must be forwarded to the Secretary on or before the 31st of May, 1842.

UNIVERSITY COLLEGE—CIVIL ENGINEERING.

The introductory lecture to this course was delivered by Professor Vignoles, at University College, on Wednesday last. The attendance of engineers and students in the large lecture-room was numerous. The learned lecturer stated that it had recently become his duty to attempt to form a distinct class in the college, for the purpose of elucidating, to those desirous of embracing the profession, the elementary principles of civil engineering; and it was mainly with that end in view that the present course of lectures had been undertaken. After a few introductory remarks upon the the nature of civil engineering, which he defined as a combination of practical skill, in conjunction with a well-grounded education on scientific principles, the learned lecturer proceeded to observe, that the use and signification of the term engineer was somewhat indefinite and obscure. In the middle ages, and long after the commencement of the last century, it was used exclusively as a military term. It was likewise applied to architecture and hydraulics; and even the term engineering, in the present day, was not less equally multiform in its application and meaning; for even from the turncock of a water company to the conductor of an engine, or the stoker of a steam-boat, all included themselves under the denomination of engineers. Very different, however, was the province and the line of study which was requisite to qualify the young engineering graduate for this noble profession. Amongst the more immediate branches of study for this purpose were to be enumerated those of mechanical, topographical, and mineral engineering. An intimate acquaintance with mathematics, a knowledge of natural and mechanical philosophy, of chemistry and economic geology, were likewise necessary in pursuing the business of civil engineering.

The stupendous aqueducts, constructed by the Romans, have been commonly stigmatized as but immense monuments of their ignorance of the simplest principles of science, inasmuch as they seem constructed in utter disregard of the now universally familiar fact, that water, if left to itself, will find its level; but the learned Professor showed that the defect in their construction were much more probably owing to the low state of the metallurgic arts in ancient times, and the difficulty if not responsibility, of their providing pumps, pipes, &c., of strength and capacity enough for sustaining the pressure of large bodies of water. Modern engineers had, he thought, but little superiority to boast of, in point either of scientific knowledge, or engineering skill. There was, however, scarcely any one branch of the arts and sciences from which an engineer might not draw important aids in the exercise of his profession. How chemistry might lend her helping hand, was strongly exemplified by the highly philosophical researches of Mr. C. W. Williams into the process of combustion, by which the long standing nuisance of smoke seemed likely to be for ever extinguished, and a saving effected of not less than 30 per cent. in the consumption of all fuel employed for engineering purposes. How a knowledge of pneumatics might be turned to good account was evidenced in the various contrivances for storing and distributing the gas with which our cities and towns are lighted, and would, he believed, be soon still more strikingly manifested in the atmospheric railway; for which we are indebted to the same ingenious individual Mr. Clegg, who invented the greater part of our gas machinery. The Professor stated that he had himself not only investigated with great care the principles of this new system of railway transit, but witnessed several most successful trials made of it, and had no doubt whatever of its coming, ere long, into most extensive and profitable use. He cited these "modern instances," (besides others which we have not space here to notice,) not so much because they were among the most remarkable of their kind, as because they were among the most recent. Although true it was that civil engineering was not made, as it ought to be, a matter of regular study by all embarking in the practice of it, and true also, that it had been hitherto almost wholly neglected as a distinct branch of education in our universities and colleges, yet he felt bound to acknowledge, and did so with great pleasure, that there were other means and other channels of acquiring information on engineering subjects, peculiar to the present day, of which engineers did avail themselves to an extent which went a great way to make up—though they could never do so entirely—for the want of early and systematic instruction. He referred particularly, and in terms of great commendation, to the establishment of the Civil Engineers, to its interesting and edifying weekly conversational meetings, and to the liberal and extensive circulation of its Transactions. Of the value of such an institution as a sort of storehouse for the communications of engineers on all subjects of interest to their profession, it was impossible to speak too highly. He might cite as an appropriate example of this, the account lately furnished to the institution by Mr. Clegg, jun., of the Portuguese viaduct of Alcantara—a work as extraordinary for its magnitude as its expense, having cost no less than about 120,000*l.* a mile. The scientific periodical press had also rendered most important service to the engineering profession; in particular the Mechanics' Magazine, and Civil Engineer and Architect's Journal. Much valuable information was to be gleaned from the periodical literature of the day, and from such works as those of Smeaton, Tredgold, Rennie, the "Transactions of Civil Engineering," and other productions. Many were the striking results which might be mentioned of the power of knowledge, where science was combined with skill, as might be illustrated in the labours of the Earl of Ross, better known in the scientific world as Lord Oxenstown, who, following in the steps of Herschell, had constructed the wonderful reflecting telescope. It was the business, he conceived, of a civil engineer, to be economical in his works, and to keep down every branch of expenditure as much as possible.

THE LEVELLING STAFF.

Sir—Observing in this month's number of your excellent Journal, a notice of some "improvements" made in levelling instruments, by Mr. T. Stevenson —I cannot refrain from a few remarks on the too great disposition now prevalent to "improve" by complication, many instruments which we have already had much improved by being simplified. I allude more particularly to the levelling staff, which has been made almost perfect by the ingenious method of "self-reading," and which when properly used, in my humble judgment renders any adjusting apparatus worse than useless.

Inventive minds when impressed with improving ideas are, in their anxiety to bring them forth, prone to overlook many attendant circumstances which more than neutralize the presupposed advantages, and such, I conceive, is the case with Mr. Stevenson, for in the attempt to attain such superlative accuracy by means of his adjusting screw and clamp, in the reading of the staff, a certain portion of both the observer's and holder's attention is absorbed, which should be entirely devoted to obtaining the exact reading when the staff is in the perpendicular position. A method which I have adopted in practice, and which may not generally be known, ensures, I may say, perfect accuracy, and allows the observer to be quite independent of his assistant—is expeditious in the extreme—and may be practised in moderately windy weather still ensuring the same accuracy of observation. It consists in instructing the staffholder to firmly and slowly move the staff to and fro in the plane of the observer, the base of the staff acting in its seat as a hinge,—during this motion, the cross wire of the telescope is seen to travel up and down, and up again on the face of the self-reading staff—the sequence of these being reversed in its return motion. The *least* reading should be always taken down as it is at this point the staff is perfectly perpendicular. I have found this plan most satisfactory and easy in practice, and I trust the judgment of any practical man will convince him of the superiority of it over any complicated adjusting screws which may be applied, and which tend greatly to increase the expense of a most simple and cheap instrument when properly made.

I am, Sir,

Your very obedient servant

Dublin, 13th Nov. William Bewley.

W. B.'s IMPROVED RAIL AND CHAIR.

Sir—Surely your correspondent W. B. must be one of those who walk through the world with their eyes shut; it would be difficult otherwise to reconcile the fact of his being "practically engaged in the construction of railways for some years," and his calling the attention of your readers to such an extremely impracticable thing as his "improved rail and chair."

W. B. starts with the astounding observation No. 1, "that the greatest strength of the rails is not in the direction of the force they are intended to bear." I can only say, if W. B. has really seen this to be the case, it can but have been on the lines on which he has been "practically engaged." Subsequently, he admits indeed that "this is assisted a little by placing the chairs declining a little inwards; but which is entirely at the mercy of the workmen employed to lay the rails." Were this true, it would be a sweeping denunciation of the whole profession; but fortunately for engineers, it is not so; the observation reflects only on W. B. himself. This important point is no more left to "the mercy of workmen," than is the gauge itself of the line; both are with the same accuracy adjusted with a template, and receive the careful attention of engineers and inspectors.

Template.

Chairs and Rails inclined.

Had W. B. known what was done on all lines but his own, he would surely in very fairness have placed the rails under his barrel in their true position, however much, giving them a vertical direction might help out the argument of his offspring.

In observations 2 and 3, W. B. complains "that there is invariably considerable attrition between the rail and chair, and between the joints of the rails," and "that the fixing of the rails is subject to failure from the loosening of the key or wedge;" which said observations lead me to suppose that his practical engagement on railways must be of rather ancient date; I shall therefore take the liberty of informing him, that in most, if not all, the later methods of laying rails, these inconveniences have been very nearly obviated; so perfect indeed, in most cases is the connection between the rail and chair, that in instances of partial subsidence, the pins are much more frequently seen drawn from the sleepers and blocks, or these lifted from their beds, than the rails parted company with, or loose even in the chairs. The latter part of W. B.'s third observation is rather a sly hit at himself. He complains of "a wooden wedge having greater force to sustain than it is able without being compressed," and yet he not only uses a wooden wedge himself, but actually compresses it until it fills a series of notches in the chair!

It is not a little singular that with all W. B.'s acute perception of the difficulties and dangers of rolling the usual "irregular forms of the present rails," as evinced in observation No. 4, and with all his practical experience, it did not occur to him that there might be some slight practical reasons to induce the whole world to battle with these difficulties, and adopt a flatheaded rail in spite of them, instead of contenting themselves with the simpler form of 'ead that could be had without them.

Having disposed of the observations, let us examine a few of the practical advantages of his "improved rail and chair;" and it will materially assist in the enquiry, if W. B., who has "practically proved the rail himself," will favour us in your next with further information on the following trivial points. As, on W. B.'s lines of railway, the position of the rails is "left entirely to the mercy of the workmen," has he not found that the "improved" may possibly cut as sorry a figure by the chair not being placed perfectly straight, as the present bungling methods may, by not being sufficiently declined? Most things, I imagine, "left to the mercy of workmen," would have as good a chance of being placed crooked as straight; and then what might not be the fatal consequence of the one-tenth less metal?

There is one point however on which the "improved" decidedly bears away the palm from all the present disadvantageous methods that I have ever seen; which is, the next to impossibility of ever unfixing the line that has once been laid with it. From the method of joining the rails, one faulty one cannot possibly be removed without two others being also taken up, and some fifteen chairs being removed from the sleepers; just increasing the work in the proportion of three to one of the present disadvantageous methods. I say fifteen chairs removed from the sleepers, for assuredly W. B. would not attempt to remove the keys and the wooden wedges he has so neatly compressed into the notches of the chairs; these could not possibly be drawn to release the rails without destruction.

Are W. B.'s lines of railway in an unknown country of equable temperature, or has the "improved" the additional practical advantage of being of metal unaffected by such sublunary causes? If not, what becomes in the winter time, of the "piece of thin cast lead," so carefully inserted between the joints? What service it would do in any season, what noise it would deaden where no noise occurs except from a loose joint, of which, no one, would accuse the "improved," I leave to W. B. to explain with the rest.

Your obedient servant,

H. A.

Sir—In the engraving of the improved chair, the ratchets are shown acute, and on enquiry I find the draftsman sketched them thus, although my directions were for the same to be drawn as shown in the models, or more obtuse, and they should have been like a wave, as I distinctly state there are no internal angles in the chairs, which would be futile if the ratchet or wave was as shewn in diagrams, figs. 3 and 4, and in fact would prevent the withdrawal of the wedge, whereas that shewn in the models I have repeatedly proved will not prevent the wood wedge being drawn or driven out after removing the iron key even without prejudice to its being re-used. My reason for having used the term ratchet was the attaining equal security as given by common ratchets

The preceding correction may seem unnecessary as it would of course be seen by a practical man, and it requires but little penetration to see it is not intended as shewn in diagrams Nos. 3 and 4, but for the benefit of those who may not have seen the models I respectfully request your insertion of the above explanation.

I am, Sir,

Your obedient servant,

W. B.

ON REVERSING ENGINES.

Sir—Seeing a plan for reversing engines in your pages, signed Geo. Coe, civil engineer, I take the liberty of sending you a few remarks, which I trust you will give a place in your Journal.

The plan which Mr. Coe has given is similar to one of which I consider myself the inventor, only that I have but one-half the work which he has shown, to answer the same purpose. He is silent on some of the most essential points; the lead of the eccentric for instance, if it be set right for going ahead, would be far from being right for going astern; the engine would be what we call too late and not be able to pass its centres, which every practical man is quite aware would not move in a contrary direction.

He further states that one man would be able to manage any of the largest marine engines that ever navigated the ocean, better than 4 or 6 or even 10 men on the present system. Now let alone what I have stated above, I will take two engines of 100 horse power, which is far from being the largest which we have navigating the seas. The steam ways that would be required for cylinders of this power should contain 55 superficial inches, 16 inches by 3½ inches nearly; the valve that would be required to cover sufficiently, would be 18 inches long and 19 inches broad, containing 112 superficial inches working together. For two engines it will be double the area, excepting one bar less will do, as the centre one acts for both engines, so that will make it equal to 217 superficial inches working together. The pressure which is on a valve of this description will be immense, taking it at the lowest figure, say 15 lb. on each square inch, 12 lb. by a vacuum being formed in the condenser, and 3 lb. of steam in the valve box or on the back of the valve, making it equal to a weight of one ton nine cwt. to be moved by one individual, which is quite impossible, unless multiplied by a long lever, which never can be done to any advantage.

I have by me a working model which I exhibited at the Hull Mechanics' Institution, on the 25th of February, 1841, and at that time I entered it at the Patent Office, London; I have since then made working sections. All the different points which I consider in the sketch given in the Journal, as deficient, I have adopted in full perfection, and proved by the working model which answers instantaneously forward, backward and stop, with the greatest ease, and can be attached to any engine at a trifling expense. An engine of 45 horse power is at the present time being made by Messrs. Overton and Wilson, engineers, Hull, in which will be introduced my improvements. I hope in a few weeks to see it in full play on the river Humber, where any one will have an opportunity of judging of its importance.

I will send you a sketch of it as soon as time will allow me.

I am, &c.,

Thomas Stather,

Foreman to Messrs. Overton & Wilson, Hull,

And an Old Subscriber.

Hull, November 17, 1841.

Sir—Page 336 of your Journal for October last, contains an article professing to be a new and advantageous plan to facilitate the reversing of steam engines. Although the plan is to me perfectly new, and will I have no doubt be found to change the action of steam very effectually, I do not conceive its peculiar advantage, either as to friction, weight, or cost in construction. On the contrary, it would in the first place cause a very considerable amount of friction, in consequence of the additional slide-valves on the opposite side of the cylinder. Secondly, the boxes for these additional slide-valves, together with the regulating valve-box and those massive pipes which form the communications between it and the other valve-boxes, would add very largely to the weight of our marine engines. Thirdly, these additional pipes, valve-boxes, the moveable joints, levers, &c., necessary to connect the two pair of double-faced slide-valves, and also those necessary to facilitate the changing and adjusting of the reversing valve, all combined, would add very materially to the cost of an engine.

However far the above inconveniences may oppose the practical application of Mr. Coe's system, it has an objection of still greater importance; which objection I trust will apologise for my thus intruding upon your pages.

It is in practice found advantageous (and is now almost universally attended to), to give the slide-valves of all reciprocating steam engines what engineers term lead and cover; the importance of which is very clearly explained in one of your late preceding numbers. Now the valves of Mr. Coe's present system could not be adjusted to produce this effect for one direction without destroying it when reversed. If then we are obliged to neglect the lead and cover, why use the reversing valve and additional double-faced slide-valves proposed by Mr. Coe, when we can obtain exactly the same result from one common single-faced slide-valve, with the addition of one simple lever merely to change the direction of the motion produced by the fixed eccentric?

With great respect, I am, &c.,

Vesper.

P.S. Should Mr. Coe, or any other of your able correspondents, think it worth their trouble to lay before the readers of your Journal a description of a complete apparatus for working steam engines expansively, that is, capable of cutting off the steam at any point between the commencement and termination of the stroke; such an article would, I presume, be at the present very acceptable.

Leeds, November 1, 1841.

ON THE THEORY OF BARS.

Sir—Mr. Brooks' letter in your Journal for the present month purports to be a reply to mine of July last; in my opinion it is not so. He accuses me of an attempt "to go off on another tack," although he has no authority for such an accusation; but he flies off, not at a tangent, but in an eccentric movement, and seizes with avidity the bonum magnum found in the Nautical Magazine for 1837. So far from abandoning the law there by me propounded, I adhere to it without qualification or reservation, *i. e.* to the fact that the *right angle* course of egress water charged with matter in suspension, and causing a conflicting action with that water into which it falls, is the cause of a bar.

He calls on me to adduce proofs of my proposition; the columns of your Journal and of others already contain a number of facts, demonstrating the accuracy of my thesis. He threatens, if I fail in "duty," to supply the omission by giving proofs "that many rivers are free from bar, notwithstanding their rectangular direction, and of numerous rivers which have bars, although their discharge is at an acute angle." It has been very properly observed that "those who discuss important subjects should be cautious in their choice of facts."

To the first of these, the rectangular course of river water not causing a bar, the exceptions are explained in my Treatise, page 5. As to the second I promptly admit that if a river do pass out in an acute angle, and be charged with matter, and have velocity adequate to cause a conflicting action with the water of the ocean, then in that case a deposit or bar would ensue. But in all my extensive and practical observations, I know of no river, nor is there *an instance* to be found in our globe, where a river at its disembogning *point* and where it *meets* the tidal water of the ocean, and commences the conflicting *action*, does pass out or meet the tide at an acute, but *invariably* at a right angle. Surely no scientific or practical man can be so uninformed as not to know that however meandering may be the interior course of a river, ere it arrives at the ocean, *naturally* and *necessarily*, it must take a perpendicular course into the sea, and *continue* that course till influenced by the ocean's tide. In some places this perpendicular or right angle course into the sea is by a long, in others by a short *sea-reach*.

Mr. Brooks has mistaken the fact, the important distinction between that course or direction of the river water at its fall into, and until it absolutely gets in contact with the tidal water; and that direction which it takes subsequent to the joining of the two waters. It is the *pressure* of the larger and heavier power of the sea tide, passing parallel with a coast, and consequently crossing the mouth of a river at right angles, which forces the water from a river to incline to the direction of the more powerful stream; and thus the river water takes an oblique or an acute angle of direction from its uninfluenced course—but for this cause, a river would continue to advance seaward in its perpendicular direction until it was exhausted, and disappeared in the vast ocean.

We see then the cause why all bars are formed on the lee-side of the entrance to a harbour, if the ebb tide come from the right, the bar invariably inclines towards the left, and *vice versa*.

In making these observations I beg it may be understood that they relate *only* to a coast where there are regular passing *tides*.

I remain, Sir, your obedient servant,

HENRY BARRETT.

72, Broughton Street, Edinburgh, November 17, 1841.

DREDGE'S SUSPENSION BRIDGE.

SIR—An entire description of my patent suspension bridge would occupy too much space in your Journal, and employ more time than I can at present spare, and as an abridgment, would perhaps produce more cavilling than would be interesting to your readers, or necessary for the investigation of truth, I will refer Mr. Fordham to a full mathematical description, which will be published in a few days, by Mr. Weale, to four foot bridges in the vicinity of the Regent's Park, and similar works in various parts of the kingdom, so that as a mathematician, and man of science, he may be able to read, see, and judge for himself, and from these evidences, form what opinion he thinks fit, and I shall be most happy to see that opinion publicly expressed through the medium of your pages.

I remain, Sir,
Your obedient servant
J. DREDGE.

METHOD OF PREPARING AND APPLYING A COMPOSITION FOR PAINTING IN IMITATION OF THE ANCIENT GRECIAN MANNER.

BY EMMA JANE HOOKER.

PUT into a glazed earthen vessel, four ounces and a half of gum-arabic, and eight ounces, or half a pint (wine measure) of cold spring water: when the gum is dissolved, stir in seven ounces of gum-mastich, which has been washed, dried, picked, and beaten fine. Set the earthen vessel containing the gum-water and gum-mastich over a slow fire, continually stirring and beating them out with a spoon, in order to dissolve the gum-mastich: when sufficiently boiled, it will no longer appear transparent, but will become opaque, and stiff, like a paste. As soon as this is the case, and that the gum water and mastich are quite boiling, without taking them off the fire, add five ounces of white wax, broken into small pieces, stirring and heating the different ingredients together, till the wax is perfectly melted and has boiled. Then take the composition off the fire, as boiling it longer than necessary would only harden the wax, and prevent its mixing so well afterwards with water. When the composition is taken off the fire and in the glazed earthen vessel, it should be beaten hard, and whilst hot (but not boiling) mix with it by degrees a pint (wine measure) or sixteen ounces more of cold spring water; then strain the composition, as some dirt will boil out of the gum-mastich, and put it into the bottles: the composition, if properly made, should be like a cream, and the colours, when mixed with it, as smooth as with oil. The method of using it is to mix with the composition, upon an earthen pallet, such colours in powder as are used in painting with oil, and such a quantity of the composition to be mixed with the colour as to render them of the usual consistency of oil colour; then paint with fair water. The colours, when mixed with the composition, may be laid on, either thick or thin, as may best suit your subject, on which account this composition is very advantageous, where any particular transparency of colouring is required; but in most cases, it answers best if the colours be laid on thick, and they require the same use of the brush, as if painting with body colours, and the same brushes as used in oil painting. The colours, if grown dry, when mixed with the composition, may be used by putting a little fair water over them; but it is less trouble to put some water when the colours are observed to be getting dry. In painting with this composition, the colours blend without difficulty when wet, and even when dry the tints may easily be united, by means of a brush and a very small quantity of fair water. When the painting is finished, put some white wax into a glazed earthen vessel over a slow fire, and when melted, but not boiling, with a hard brush cover the painting with the wax, and when cold take a moderate hot iron, such as is used for ironing of linen, and so cold as not to hiss if touched with anything wet, and draw it lightly over the wax. The painting will appear as if under a cloud till the wax is perfectly cold, as also, whatever the picture is painted upon is quite cold; but if, when so, the painting should not appear sufficiently clear, it may be held before the fire, so far from it as to melt the wax but slowly; or the wax may be melted by holding a hot poker at such a distance as to melt it gently, especially such parts of the picture as should not appear sufficiently transparent or brilliant; for the oftener heat is applied to the picture, the greater will be the transparency and brilliancy of colouring; but the contrary effects would be produced if too sudden or too great a degree of heat were applied, or for too long a time, as it would draw the wax too much to the surface, and might likewise crack the paint. Should the coat of wax put over the painting when finished appear in any part uneven, it may be remedied by drawing a moderately hot iron over it again as before mentioned, or even by scraping the wax with a knife; and should the wax, by too great or too long an application of heat, form into bubbles at particular places, by applying a poker heated, or even a tobacco-pipe made hot, the bubble will subside; or such defects may be removed by drawing anything hard over the wax, which will close any small cavities.

When the picture is cold, rub it with a fine linen cloth. Paintings may be executed in this manner upon wood, (having, first, pieces of wood let in behind, across the grain of the wood to prevent its warping), canvas, card, or plaster of Paris. The plaster of Paris would require no other preparation than mixing some fine plaster of Paris in powder with cold water the thickness of a cream; then put it on a looking-glass, having first made a frame of bees-wax on the looking-glass, the form and thickness you would wish the plaster of Paris to be of, and when dry take it off, and there will be a very smooth surface to paint upon. Wood and canvass are best covered with some grey tint mixed with the same composition of gum-arabic, gum-mastich, and wax, and of the same sort of colours as before mentioned, before the design is begun, in order to cover the grain of the wood or the threads of the canvas. Paintings may also be done in the same manner with only gum water and gum-mastich, and wax; but instead of putting seven ounces of mastich, and when boiling, adding five ounces of wax, mix twelve ounces of gum-mastich with the gum water, prepared as mentioned in the first part of this receipt; before it is put on the fire, and when sufficiently boiled and beaten, and is a little cold, stir in by degrees twelve ounces or three-quarters of a pint (wine measure) of cold spring water, and afterwards strain it. It would be equally practicable, painting with wax alone, dissolved in gum water in the following manner. Take twelve ounces or three-quarters of a pint (wine measure) of cold spring water and four ounces and a half of gum-arabic, put them into a glazed earthen vessel, and when the gum is dissolved, add eight ounces of white wax. Put the earthen vessel with the gum-water and wax upon a slow fire, and stir them till the wax is dissolved and has boiled a few minutes; then take them off the fire and throw them into a basin, as by remaining in the hot earthen vessel the wax would become rather hard; beat the gum-water and wax till quite cold. As there is but a small proportion of water in comparison to the quantity of gum and wax, it would be necessary, in mixing the composition with the colours, to put also some fair water. Should the composition be so made as to occasion the ingredients to separate in the bottle, it will become equally serviceable if shaken before used to mix with the colours.

I had lately an opportunity of discovering that the composition which had remained in a bottle since the year 1792, in which time it had grown dry and become as solid a substance as wax, returned to a cream-like consistence, and became again in as proper a state to mix with colours, as when it was first made, by putting a little cold water upon it, and suffering it to remain a short time. I also lately found some of the mixture composed of only gum-arabic water and gum-mastich, of which I sent a specimen to the Society of Arts in 1792; it was become dry, and had much the appearance and consistency of horn. I found, on letting some cold water remain over it, that it became as fit for painting with as when the composition was first prepared.—*The Art Union.*

An elegant painted window, designed and executed by Mr. Willement, of London has just been erected in St. George's Chapel, Edgbaston, by the subscriptions of the congregation.

ROADS AND CANALS IN INDIA.

The progress of internal communication in Bengal is developed at great length in a report made in the month of August last to the Government authorities by the military board, which, besides containing an account of what has been done during the official year ending April, 1841, gives a general review for the past twenty years. In this review we find the Grand Turk-road from Calcutta, described as the main artery of communication throughout Bengal and Hindostan, extending to a length of 770 miles, with a general breadth of thirty feet, increased in some places to forty. It has already 1,102 bridges of various extent of opening, has cost, exclusively of convict labour, 1,228,000 rupees, and is likely to cost 10 lacs more during the three years required for its completion. The road from Pooree to Bissenpore, which connects Orissa with Bengal, and which is commonly known as the Juggernauth road, is held to be of the next importance, and has cost about 15 lacs, or at the rate of 5,415r. the mile. The expense of the road from Calcutta to Kishnagur is estimated at 2,700,000r., or 4,756r. the mile for the seventy miles. The road from Sylhet to Gowhatty, the capital of Assam, across the Cassia hills, was in active preparation, and in this line of communication the two torrents of the Bur-panee and the Boga-panee are to be spanned with suspension-bridges. The Deccan road from Mirzapore to Jubbulpore, a distance of 239 miles and commenced in 1824, had been completed lately; its cost in the 15 years, exclusive of the labour of convicts, had been 8 lacs of rupees. Another road, small in point of expence, but of great importance, was also in progress from the eastern frontier of Bengal, through Cachar, and across the Munipore hills to the limits of the Burmese empire. Besides these roads, which are stated to be the most prominent, a variety of districts roads have added greatly to the local conveniences of the people, and have proportionately occupied attention. The total outlay for all the roads to which allusion is made has been 57,34,225r., and from which there is no return. A toll on a road is unknown.

The canals which fringe the eastern part of the city of Calcutta, and connected with the Isamuttee river, are of the highest importance to the welfare of the city, as the produce of all the eastern districts is thus brought to it with little or no risk. These have cost in the whole about 16½ lacs of rupees, which now includes the erection of five suspension bridges. To improve Tolly's Nullah, seven suspension bridges have been thrown across it at a cost of 179,381r. The canals west of the Jumna have been repaired at an expense of 1,566,500r., which, with a further outlay on the Dooab Canal, west of the Jumna, of 579,164r., makes, with other expenditure, a total outlay of 4,063,288r. in constructing and repairing canals in the presidency. The canals are very productive of revenue, for the tolls on those in the vicinity of Calcutta are said to yield on an average 121,800r. a year, while the annual average charge for their maintenance appears to be about 15,000 rupees. Hence it is argued, that the Government cannot do better than lay out funds for their extension and improvement. In reference to these canals it is remarked, that while the toll remained at the rate of one rupee the 100 maunds, the proceeds were 125,000r., but when the Government liberally reduced the levy by one-half, they fell in the succeeding year to about 60,000r. This fall, it was ultimately discovered, arose mainly from the corruption of the native collectors, which had been so far remedied by close observance, that in the last year (1840) the collection again rose to 122,000r., showing that the state receives the same return as when the import was double its present amount. The canals east and west of the Jumna exhibit the most gratifying results, not only in respect of the means they supply to the agricultural community for the irrigation of upwards of 100,000 acres of land, but indirect money returns. The sum expended on the canals west of the Jumna by the British Government has been 1,566,500r., and the annual amount levied as water rent is 258,826r., or more than 16½ per cent. While the outlay has therefore been in the whole 15½ lacs of rupees, the returns up to the end of the year 1840 had been 21½ lacs. In restoring the Dooab Canal, the cost to the government was 5 lacs and 80,000r. The direct return in rupees up to the end of 1840 has been 5 lacs and 13,000r. At the end of the official year, the whole sum expended by the Government had been reimbursed to the public coffers, and an annual income of 6,000r. might be expended for the future. The tolls on the Nuddea river produce a clear annual surplus of one lac and 12,000r. And now adverting more particularly to what has been done during the official year of 1840, we find that in the department of canals the Government has sanctioned an outlay of 23,000r. for deepening a canal in the Hedgelee district for the express object of facilitating the transportation of salt. The other expenses in connexion with canals have been incurred partly in reference to those near Calcutta, and partly to those on the east and west of the Jumna. The former appear to have cost in necessary repairs a sum of about 14,000r. independently of an iron suspension bridge at Ooltadanga, over the Circular Canal, amounting to 12,000r. On the Dooab Canal has been expended 71,500r. in the construction of aqueducts, with the view to the further extension of the benefits of irrigation. The total amount of money expended in canals during the year under consideration was 2,57,813r.; the returns 4,69,197r., being a clear profit of 2,11,384r. The new roads were progressing steadily. The road from Burdwar to Benares is completed, as far as regards earth work, to its full height and width. On this undertaking there had been an outlay of 6,00,000r., and it will require an equal outlay to complete it. The road from Patna to Gya would have the benefit of a grant of 70,000r., and for the road to Darjeeling a revised estimate of 28,000r. would be appropriated. The proposed road from Agra to Bombay had been negatived from the fact of the enormous expense it would entail. The total outlay in public works for that period was 9,69,686r., which produced a return of 4,69,197r., thus leaving 5,00,489r. as the difference between expenditure and return. On this the India journals remark that it is an expenditure of less than one per cent. on the land revenues of these provinces, and that however much the public may be grateful for these improvements, it exhibits much niggardness as compared with the revenue the Government authorities derives from the territory of which they are the useful and necessary embellishment.—*Times.*

COMMUNICATION FROM THE ATLANTIC TO THE PACIFIC OCEAN, ACROSS THE ISTHMUS OF DARIEN, OR PANAMA.

A project has been started for forming a road or railway communication from Chagres to Panama, which probably will not exceed in length 42 miles, and over a gross ascent between the two oceans of about 500 feet. It is proposed to be constructed on the surface, (that is, without a tunnel) thereby the danger arising from earthquakes will be much lessened.

It is stated that by this route, and using steam navigation across the Atlantic and Pacific oceans, the passage from England to the colonies of New Zealand, Van Dieman's Land, and to Australia generally, may be reduced from five months to ten weeks, and also that the passage from England to the coast of Chili and Peru, would be reduced to 35 or 40 days. The advantages of a road or way across the isthmus will be very great, not only to England but to the whole of Europe and America. Steam packets will shortly be established between England and the Atlantic shore of the Isthmus; steam boats are already working along the coast of Chili and Peru, and there is little doubt that a complete steam navigation will be effected within a short time from Panama to New Zealand and other British colonies in New South Wales.

It only remains, therefore, (to render this route perfect) to construct a road or railway across the neck of land, and to show that every facility would be afforded by the government of New Granada, in the execution of such a work, that Congress is willing to grant extensive privileges on those parties undertaking the project.

Pile-driving Machine.—An ingenious machine for driving a double row of piles, has recently been imported from the United States. It was built at Utica, and has the national name "Brother Jonathan" inscribed on it. It is now in operation at Smith's timber wharf, Pedlar's Acre, where it can be seen driving the piles for the causeway and abutment on the Surrey side of the New Hungerford Market Bridge, now in progress. The rams or "monkeys" are elevated to a height of 35 feet or thereabouts, along grooves in perpendicular ladders, similar to the ordinary machine, by means of a locomotive steam engine of 10-horse power, fixed on a platform, on which the whole of the machinery is placed. The power of the blow given by each of these hammers exceeds 600 tons, and drives a pile of 27 feet long, and as thick as the thickest piles used in embankments and for coffer-dams, nearly its whole length into the earth in about eight minutes, or perhaps less. It drives two piles at the same time. A circular horizontal saw is worked by the engine, which, in a few seconds, cuts the tops of the piles even, and enables the trucks, or small wheels on which the platform is supported, to come forward as fast as the piles are driven, and cut them even at the top; The power of this machine is astounding, and requires to be seen to be fully estimated. It is an important application of steam power, likely to produce very beneficial results in public works, in the formation of sea banks, and in all operations on a large scale where rapidity of execution and precision are required. The machine was used in America for driving piles for railways; and travelled by its own power upwards of 200 miles, driving piles, and making its own road through swamps and districts heretofore impervious. It is patented in this country, and also in the United States. The machine has, moreover, the power of drawing piles out of the earth as quickly as it drives them in, and can be applied to the raising of blocks of stones, and all heavy weights that require an extraordinary power. It is almost indispensable for all persons immediately connected with engineering and science to see it. We hope next month to be able to give drawings and a description of the machine.

REPORT FROM THE SELECT COMMITTEE ON FINE ARTS.

The report of the above committee, together with the minutes of evidence taken by them, have been printed by order of the late House of Commons. Amongst the witnesses examined were Mr. C. Barry and Sir Martin A. Shee. We shall now proceed to give an abstract.

The committee commence by stating, that although the then approaching dissolution compelled them to conclude their inquiry somewhat abruptly, still they have obtained the opinions of some distinguished professors and admirers of art, who are unanimously of opinion that so important and national a work as the erection of the two Houses of Parliament affords an opportunity which ought not to be neglected of encouraging not only the higher but every subordinate branch of fine art in this country. In this opinion the committee state their entire concurrence, supported as it is by witnesses of extensive information, and by artists of the highest ability. The committee, however, in recommending that measures should be taken without delay to encourage the fine arts, by employing them in the decoration of the new Houses of Parliament, desire to express their decided opinion, that, to accomplish this object successfully, it is absolutely requisite that a plan should previously be determined upon, and that as soon as practicable, in order that the ar[illegible] they may [illegible] with [illegible].

The committee are not, in the present stage of the inquiry, prepared to suggest the details of a plan; but they think that a commission might most usefully be appointed [illegible] depart[illegible] of the Government [illegible] consideration, should be solely [illegible] the execution of the plan [illegible] to realize the objects of the committee.

Whether, however, a commission be appointed or not, the committee think that it is most desirable that the advice and assistance of persons should be sought, who are competent, from their knowledge of art, and their acquaintance with great public works, both at home and abroad, to give, in conjunction with the architect, the most effectual means of [illegible] of [illegible] the appointment of the committee [illegible] at the fine arts of this country. By taking this course, the [illegible] and the other artists will be enabled to understand and assist each other's views; and thus the abilities of both would be exerted for the decoration of so eminently national a building, and, at the same time, encouragement, beyond the means of private patronage, would be afforded, not only to the higher walks, but to all branches of art.

The committee state that their attention has been called to one branch of the fine arts hardly known in this country—namely, fresco painting, which has lately been revived on the continent, and employed in the decoration of public buildings, especially at Munich. The space which it demands for its free development, and the subjects which it is peculiarly fitted to illustrate, combine to point out national buildings as almost the only proper sphere for the display of its peculiar characteristics—grandeur, breadth, and simplicity. The committee, after a careful consideration of the evidence, are disposed to recommend that this style or mode of painting should be adopted. They fully concur in the opinion of Mr. Eastlake, that England possesses artists equal to the occasion, whose genius only wants that exercise and encouragement which this great opportunity may be made to afford. But the committee suggest, that if fresco painting should be employed in the decoration of certain portions of the new buildings, it would be a safe and judicious plan to give the artists an opportunity of making some experimental efforts in the first instance.

The committee then quote a passage from a valuable paper on fresco painting, written by Mr. Eastlake, given in the Journal of last month.

With reference to another branch of the inquiry—the cost incident to an extensive and well-devised plan for the public patronage and encouragement of art—the committee, notwithstanding that they are aware that objections are entertained by many to a large expenditure of the public money for such a purpose, are of opinion, independently of the beneficial and elevating influence of the fine arts upon a people, and every pecuniary outlay, either for the purpose of forming or extending collections of works of art in this country, has been directly instrumental in creating new objects of industry and of enjoyment, and therefore in adding at the same time to the wealth of the country.

The committee state, that the collection of vases made by Sir W. Hamilton led to the introduction of a new branch of manufacture in this country by Mr. Wedgwood, which not only employed artists and artizans, but tended to improve every branch of a great staple trade, and in its results elicited from the hands of comparatively ordinary workmen works almost rivalling their originals in texture, form, and beauty. The committee further remark, that the collection of Sir W. Hamilton's ancient Greek vases (for the purchase of which a sum of £8,400 was granted by Parliament) was a great acquisition to the country, and ought to have opened the eyes of the Government to the utility arising from similar acquisitions. "The discovery of these vases (the committee observe), and their communication to the public by engravings, coinciding with the discoveries of Herculaneum and Pompeii, may be considered an essential epoch in the history of the arts, and which contributed greatly to their revival."

The committee observe that the beneficial influence of art upon the character of the people may, it is hoped, be inferred from the gradually increasing numbers, of late years, who take an interest in the national collections. This fact has been fully proved by the report of the select committee on "national monuments and works of art," of which we, some time ago, laid an abstract before our readers. "The habit," says Reynolds, "of contemplating and brooding over the ideas of great geniuses till you find yourself warmed by the contrast, is the true method of forming an artist-like mind. It is impossible, in the presence of those great men, to think or to invent in a mean manner; a state of mind is acquired that receives ideas only which relish of grandeur and simplicity."

As then the collection and exhibition of works of art have not only tended to the moral elevation of the people, but have also given a fresh stimulus and direction to their industry, so the committee is of opinion that a direct encouragement of the higher branches of art on this occasion will have a similar effect in a still higher degree.

The committee then refer at some length to the evidence given by Mr. T. Wyse, the late M.P. for the city of Waterford, and one of the Lords of the Treasury. We regret that our space will not allow us to enter into a detail of it; the evidence of Mr. Wyse goes to show the effect produced upon a nation and its industry by the public patronage of the fine arts, which he illustrated by the example of Bavaria, &c.

The committee, after referring to the evidence of Mr. Dyce, thus conclude their report:—

"Your committee, from the abrupt termination of the session, and consequently of their inquiry, have not had the opportunity to form any fair estimate of the expense of carrying out the views here stated; but they are, however, of opinion, that judging from the manner in which great works have been effected on the continent, and by the adoption in the outset of a well-considered plan for the employment of artists, and the application of the arts, a moderate annual expenditure would accomplish very important results, if not all that can be desired. They think that the very fact of a [illegible] by the [illegible] of the opportunity of encouraging the arts, by associating them with our public architecture, our legislation, our [illegible], and our history, would alone stimulate and raise their character and quality, and extend their beneficial influence over a still wider circle. "I consider it," says Sir M. A. Shee, "a most favourable opportunity for calling forth the genius of our country, and promoting the fine arts to the utmost extent of which they are capable; it is the only opportunity that has occurred for many years, and if it be suffered to pass unheeded, I should say that there is no hope in this country for artists in the higher departments of the arts."

"Whilst your committee, in conclusion, regret that they could not investigate the whole subject so fully as they desired, and as its importance demanded, they unanimously recommend the evidence herewith presented to the house to its favourable consideration, with a view to its receiving the immediate attention of the Government, and in the hope that our new Houses of Parliament may hand down to posterity a memorial, as well as the genius of our artists, as of the importance attached by the country to the nobler productions of art; and that the subjects embodied in such representations, whether by painting or sculpture, may serve to perpetuate the events of the past history, and the persons of our public benefactors, in the grateful remembrance of the people."

Whitehall, November 22, 1841.—The Queen has been pleased to appoint His Royal Highness Prince Albert, K.G., the Right Honourable Lord Lyndhurst, his Grace the Duke of Sutherland, K.G., the most Honourable the Marquess of Lansdowne, K.G., the Right Honourables the Earl of Lincoln, the Earl of Shrewsbury, the Earl of Aberdeen, K.T., Lord John Russell, Lord Francis Egerton, Viscount Palmerston, G.C.B., Viscount Melbourne, Lord Ashburton, Lord Colborne, Charles Shaw Lefevre, Sir Robert Peel, Bart., Sir James Robert George Graham, Bart.; Sir Robert Harry Inglis, Bart., Henry Gally Knight, Esq., Benjamin Hawes, jun., Esq., Henry Hallam, Esq., Samuel Rogers, Esq., George Vivian, Esq., and Thomas Wyse, Esq., Her Majesty's Commissioners for inquiring into the best mode of promoting the Fine Arts in the United Kingdom.

ON INCREASING THE EVAPORATING POWER OF BOILERS.

At the general monthly meeting of the Polytechnic Society, Liverpool, Mr. Williams read a paper on increasing the evaporating power of boilers who was provided with a number of working models wherewith to illustrate his views, addressed the meeting in a very clear and scientific manner on this important subject, developing a most interesting discovery of his own, which (already practically tested) will be extremely valuable as effecting a more rapid generation of steam, without increasing the size of the vessel, or the requirement of additional fuel. The question, he said, involved the improvement of our boilers by a very simple contrivance, whether as applied to land engines, or to the advancement of steam navigation. There were two leading considerations in the application of fuel, which were, unhappily, confounded; one the generation of heat; and the other, its application. The first appertained more peculiarly to chemical science; and the second, to mechanical appliance. The object in view was, to transmit the greatest possible amount of heat for the generation of steam, with a given quantity of fuel. Heat was imparted by two distinct media, namely, radiation and conduction. By radiation, heat was conveyed to bodies not placed in contact, as was evinced by placing the hand pretty close to the flame of a candle. By conduction, heat was conveyed by metal or other substances not consumable. In the heating of boilers, both modes were necessarily operative. In radiation, the evolved proceeded in direct lines, or radii, from the combustion to the boiler or other body exposed to it. If a thermometer were placed with the ball near the candle, the mercury would rise by radiation; but if placed immediately over the flame, the heat would be greater, but different in the mode; for, in this case, it was not fairly radiation, but a compound medium, radiation and the heated and ascending gas being combined. The speaker then exhibited the model of a boiler, with its tortuous flues, through which the several gases passed; and expressed his conviction, that nine-tenths of the heat in marine and land engine boilers was immediately received from the furnace and flame-bed, and not from the gases, which might be made available to the same end by an improved construction of boiler. The general opinion of parties working steam engines was, that to increase the size of the furnace would add to the heating of the whole boiler; but this, he considered, was treating the boiler with great neglect, for the object could be accomplished without such increase of the furnace. The means of conducting heat to water in boilers had been much neglected, reliance being almost solely placed on increasing the length of the flues. His plan was to insert a number of iron pins through the plates of the boiler, one end of them projecting into the flue and the other into the water in the boiler. These pins, exposed at one end to the heat in the flue, acted as powerful conductors, through the boiler-plates, of the heat into the water. Hitherto, the question of the mere surface of plate exposed to the flues had been alone considered; and the only remedy for defective generation of steam was conceived to be an increase of that surface. The conducting pins, however, were found to arrest the heating gases in their progress along the plates of the boiler, and greatly to hasten the generation of steam. A pin of half-an-inch in diameter projecting three inches into the flue, gave a heating surface of $1\frac{1}{2}$ inches, and by its conducting power and interior projection (as we understood the speaker) that half-inch gave as much heat as $9\frac{1}{2}$ inches on the outer surface of the plate. Air was a good conveyor, but a bad conductor of heat; for it carried most of it out of the chimney. His object was to arrest the heat in its progress, and give it out at the right place. The current of heat passing along the plates of the boiler rendered them only traverse conductors; but the heated pins were longitudinal conductors. He also showed several iron pins that had long been experimentally in use in the boiler of a steam vessel with great success. He had endeavoured to ascertain the proper lengths of which they should be, so as to remain as durable conductors of heat. One of seven inches in length had become slightly oxidized. Another, of 4 inches long, was so little affected that the smallest mark of the hammer, which it ordinarily bore, was distinctly visible. He, therefore, considered about 4 inches to be the proper length. He further illustrated his invention by three evaporating pans, one of them with pins projecting into the boiler and also into the flues, which he called double conductors; another with pins projecting into the flue only, called single conductors; and the third, a plain boiler, on the usual plan without any such conductor. The first he had found the more powerful in producing speedy evaporation; though the second was scarcely inferior. The third, or plain boiler, was greatly behind either in evaporating power. A gas lamp was affixed at one end of the double conducting pan, containing 22 lb. of water, and the evaporation appeared to be rapid. With 30 feet of gas the evaporation was as follows:

	Evaporation.		Waste Heat.
Common Pan	1 lb.	14 oz.	408
Single Conductors	7	13	320
Double Ditto	8	5	284

Here we see the quantity evaporated is in an inverse ratio to the waste heat by the chimney. He had tried them often with precisely the same results, so that there could be no error.

He then combated, in a clear and comprehensive manner, an opinion expressed by Dr. Fyfe, of Scotland, in a tract published by him, that anthracite was the best fuel or coal for engine boilers. That opinion was founded solely on the fact that anthracite contained the greatest quantity of fixed carbon or, in other words, left the greatest residue of coke. He differed from the deduction of the doctor, with whom he had corresponded on the subject. That gentleman had begun at the wrong end; he should have considered not the fuel alone, but the vessel in which it was consumed. He (Dr. F.) had taken no means to ascertain the quantity of heat that escaped in the gases or by the chimney. He had set down the hydrogen at nought, because he had not had the power of consuming it by the common furnace and boiler. He (Mr. W.) felt certain that the common Scotch coal was superior, if properly employed.

Mr. Williams's communication was listened to with great attention, and he was frequently greeted by bursts of applause. Shortly before he concluded, Mr. Dunance, engineer of the Liverpool and Manchester Railway, stated that he had tried the pins on the lecturer's principle in the boiler of one of their stationary engines with great success. He had only 105 pins driven into the boiler, and the steam, which could not before be kept up, was now abundant.

The Chairman then invited discussion on the subject, and some doubts were expressed and questions put as to the advantages of the invention, all of which were ably replied to by Mr. Williams, and ended in the complimentary acknowledgment of all who demurred, and the concurrence of all who were present, that the invention constituted a valuable and immense practical improvement in the construction of engine boilers.—*Liverpool Albion.*

FINAL TRIAL OF THE DEVASTATION STEAM FRIGATE

Commander Hastings Reginald Henry, and all the officers of this fine vessel attended on Tuesday Nov. 2 on board, to make a final trial of her capabilities previous to the engines being reported upon to the Lords Commissioners of the Admiralty. At 11 o'clock in the forenoon Captain the Hon. J. F. F. De Ros, R.N. and F.R.S.; Captain the Hon. Edward Plunkett, R.N., and several scientific gentlemen; Messrs. Maudslay and Field, engineers; and Mr Ewart, chief engineer of the Woolwich Dockyard, went on board, and shortly afterwards the vessel was loosed from her moorings, off Woolwich, proceeded down the river to Long Reach, to the measured ground, where the speed of steam-vessels is ascertained with the greatest correctness.

On this occasion the Devastation, for the purpose of giving her a fair trial, and testing her powers, had a cargo of 320 tons of coal put on board, and 61 tons of water in casks. Her draught of water was 13 feet 4 inches forward, and 14 feet aft, which afforded her paddle-wheels a depth of water sufficient to propel her with greater velocity than on the former occasion, although the strokes of the engine were only the same number, about 18 to 19 per minute. She accomplished the measured mile against the tide in 5 minutes and 48 seconds, and with the tide and against the wind in 4 minutes and 42 seconds, being nearly at the rate of 12 and 1-5th statute miles on the average per hour. Mr. Ewart, the chief engineer, whose duty it will be to report as to the efficiency of the engine, and the speed of the vessel, expressed himself in the highest terms relative to the ease and smoothness of her motion, and added, that "he never timed any that could approach her in speed before, and he was of opinion she was decidedly the fastest vessel in Her Majesty's navy."

The result of this trial is one of great importance to the country, and of which it has reason to be proud, as the engines are the simplest, as they have proved to be the most efficient, of any yet introduced to public notice, and on that account our steam navy will be far superior to the steam navy of any other country. Messrs. Maudslay and Field have done themselves great credit by the liberality with which they undertook to fit this vessel, as a specimen of the advantages of their invention, and are deserving of the complete success they have met with, and there can now be no doubt their engineer will be introduced into all the new powerful vessels built for Her Majesty's service in future. The disconnecting roller was tried during this trip, and in one minute and a quarter one of the powerful paddle-wheels, 25 feet in diameter, was detached from the engines, and the whole of their power applied to the other wheel. In three quarters of a minute the stupendous lever of the wheel was again attached, and the vessel sped through the water with the greatest velocity. On returning up the river, she overtook the Manchester and Duchess of Kent large steam vessels, and their crews appeared astonished that the Devastation had got so far a-head of them before they arrived opposite Woolwich.

The Lords Commissioners of the Admiralty have very judiciously complied with the application of Commander Henry, and ordered one of Porter's anchors, of 28 cwt., for the Devastation, and it was delivered at the dockyard yesterday, for the purpose of being tested. Commander Henry Boye, of the Vixen steam frigate, of the same mould as the Devastation, has obtained an order to be supplied with one of Porter's anchors of the same weight, to be delivered in about a fortnight.

MISCELLANEA.

Kent.—The ceremony of laying the first stone of a new church at Platt, in the parish of Wrotham, was performed on the 8th ult., in the presence of a large concourse of spectators, by the daughter of the rector of Wrotham, the Rev. Geo. Moore. The architects are Messrs. Whitehead and Walker, of Maidstone. The church about to be erected is on a site, the gift of — Lombard, Esq., being part of three acres of land which it is contemplated to lay out in a picturesque and advantageous manner, in building a parsonage house, school rooms, and alms-houses. The church will be built of Kentish rag stone, in the early pointed style, and is cruciform on plan. The dimensions within the walls (exclusive of the tower) are 78 feet from east to west, and 60 ft. 6 in. from north to south, by 25 ft. 6 in. in width. It has a tower at the west end 70 ft. in height and 21 feet square, with an octangular turret at the north-eastern angle, in which is a stone staircase, leading to the various floors, and roof, of the tower. The organ gallery (the only one in the church) is situate in the tower, and is lighted by a large 3-light window in the western wall. The chancel has a corresponding window, under which is a series of small pointed arches, and on either side a niche to serve as a seat for the officiating minister. The roof is an ornamental open timber-framed roof, with hammer beams and moulded ribs running down, and resting on stone moulded corbels. At the intersection of the transepts, the trusses are placed diagonally. The church will contain sittings for 500 persons, 120 in pews, 210 in free seats, and 170 for children. The pews are placed in the transepts, the free seats in the nave, and the children on raised seats, at the west end of nave, and in the organ gallery. The ends of all the seats next the aisles, are moulded and finished with a carved finial. The pulpit and reader's desk are placed at the south-east angle of the intersection of the nave and transepts. The total cost of the church will not exceed £2500.

Tracing Paper.—We have received from Mr. Dixon a sample of drawing paper made perfectly transparent for the purpose of tracing off drawings, which will be a great acquisition to the profession, that was much wanted, the ordinary tracing paper being too flimsy for general use.

Sir Francis Chantrey.—We regret to announce that this highly talented sculptor, died suddenly on the 26th ult.

The following is a summary of a comparative statement of houses inhabited, &c., in Great Britain and islands in the British seas in 1801, 1811, 1821, 1831, 1841:—

	Houses Inhabited.	Uninhabited.	Building.
1801.			
England	1,467,870	53,965	
Wales	108,053	3,511	
Scotland	299,553	9,537	
1811.			
England	1,678,006	47,925	15,189
Wales	119,398	3,095	1,019
Scotland	304,093	11,329	2,341
1821.			
England	1,951,973	66,055	18,289
Wales	136,183	3,652	985
Scotland	341,474	12,657	2,405
Islands in British Seas	13,763	427	98
1831.			
England	2,326,022	113,885	23,462
Wales	155,522	6,030	1,297
Scotland	369,393	12,719	2,568
Islands in British Seas	15,658	697	226
1841.			
England	2,753,295	162,756	25,882
Wales	188,196	10,133	1,769
Scotland	503,357	24,307	2,760
Islands in British Seas	19,159	865	220

The Foundation Stone of a New Church at Manchester.—The committee of the Ten Churches Association have commenced, on Pin Mill Brow, the erection of ... [illegible] ... the Church St. S... [illegible] ... built in the Norman ... architecture ... are towers surmounted by octagonal spires ... the windows ... and ... columns. Messrs. Stark and Co. are the architects. The dimensions of the church are 56 feet by 90, and it is calculated to accommodate about 1,100 persons. One-half of the sittings are to be free.

Opening of the Sheffield and Manchester Railway.—On the 17th ult. a portion of this line of railway extending from Manchester to Godley, a distance of seven miles, was opened to the public. At present but a single line of rails is laid, so that the train at one end leaves immediately after the arrival of the train from the other, by which all danger of accident from collision is avoided. The line, so far as it is yet open, after the first embankment and the viaducts, is chiefly in cuttings. It was inspected by Sir Frederick Smith last week, who certified to the perfect stability of the works and its fitness for opening. There are three engines at present on the line with their tenders, and three first-class, five second-class, and six third-class carriages. The engines were manufactured by Messrs. Kirtley and Co., of Warrington, and the carriages are from the manufactories of Messrs. Dunn and Son, Lancaster, Messrs. Allcard and Co., Warrington, and Mr. Bradley, of Sheffield.

Thames Tunnel.—A thoroughfare was effected in this work on the 14th ult., and made use of for the first time by the whole of the directors and some of the original subscribers, who had assembled upon the occasion. The shield having been advanced to the shaft at Wapping, a considerable opening was cut in the brickwork, and it was through this the party who had met at Rotherhithe were enabled to pass, thus opening the first subterranean communication between the opposite shores of the river. Upon their arrival at the shaft the party was greeted by the workmen with most hearty cheers. The engineer, Sir J. Brunel, appeared highly gratified at the happy result of all his past anxiety and arduous labour. The shield will continue its advance until it has afforded space for the formation of the remainder of the tunnel, which is expected to be completed in about three weeks.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 2ND NOVEMBER, TO 28TH NOVEMBER, 1841.

Six Months allowed for Enrolment.

William Golden, of Huddersfield, gun-maker, and John Hanson, of the same place, lead-pipe manufacturer, for "*certain improvements in fire-arms, and in the bullets or other projectiles to be used therewith.*"—November 2.

Thomas Macauley, of Curtain-road, upholsterer, for "*certain improvements in bedsteps, which are convertible into other useful forms or articles of furniture.*"—November 2.

Robert Logan, of Blackheath, Esq., for "*improvements in obtaining and preparing the fibres and other products of the cocoa nut and its husk.*"—November 2.

Robert Holt, of Manchester, cotton-spinner, and Robinson Jackson, of Manchester, aforesaid, engineer, for "*certain improvements in machinery or apparatus for the production of rotary motion, for obtaining mechanical power, which said improvements are also applicable for raising and impelling fluids.*"—November 2.

Moses Poole, of Lincoln's-inn, gentleman, for "*improvements in machinery, used in the manufacture of bobbin-net or twist lace.*" (Being a communication.)—November 2.

Henry Kirk, of Tavistock-square, gentleman, for "*a substitute for ice for skating and sliding purposes.*"—November 2.

William Brunton, of Neath, Glamorganshire, engineer, for "*an improved method or means of dressing ores and separating metals or minerals from other substances.*"—November 2.

Jeremiah Bynner, of Birmingham, lamp-maker, for "*improvements in gas burners.*"—November 2.

Edward Robert Simmons, of Croydon, Esq., for "*improvements in apparatus for preventing splashing in walking.*"—November 2.

Henry King, of Webber-row, Westminster-road, engineer, for "*certain improvements in steam engines and boilers.*"—November 4.

Jules Lejeune, of North-place, Cumberland-market, manufacturing chemist, for "*a means of condensing and collecting the sulphurous and metallic vapours which are evolved in the treatment by heat of all kinds of ores.*"—November 4.

Job Cutler, of Ladypool-lane, Birmingham, gentleman, for "*improvements in the construction of the tubular flues of steam-boilers.*"—November 6.

John Carr, of North Shields, earthenware manufacturer, and Aaron Ryles, of the same place, agent, for "*an improved mode of operating in certain processes for ornamenting glass.*"—November 9.

Jesse Ross, of Leicester, manufacturer, for "*a new wool-combing apparatus.*"—November 9.

Henry Davies, of Birmingham, engineer, for "*certain improved machinery suitable for applying power to communicate locomotion to bodies requiring to be moved on land or water.*"—November 9.

Jesse Smith, of Wolverhampton, lock-maker, for "*improvements in the construction of locks and latches, applicable for doors and other purposes.*"—November 9.

William Edward Newton, of Chancery-lane, civil engineer, for "*certain improvements in the production of ammonia.*" (Being a communication.)—November 9.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for "*improvements in the manufacture of candles.*" (Being partly a communication.)—November 9.

John Garnett, of Liverpool, merchant, and Joseph Williams, of Liverpool, aforesaid, manufacturing chemist, for "*an improved method of manufacturing salt from brine.*"—November 9.

John Burnell, the younger, of Whitechapel, manufacturer, for "*improvements in the manufacture of leaves or sheets of horn, commonly called lantern leaves, and in the construction of horn lanterns.*"—November 9.

John Edwards, of Cow Cross-street, gentleman, for "*an improved strap or band, for driving machinery, and for other purposes.*"—November 9.

James Stewart, of Osnaburgh-street, St. Pancras, pianoforte maker, for "*certain improvements in the action of horizontal pianofortes.*"—November 11.

George Allarton, of West Bromwich, Stafford, surgeon, for "*certain improvements in the method of balling and blooming iron.*"—November 11.

John Peter Booth, of Hatton-garden, feather-merchant, for "*certain improvements in the manufacture of a substance, or compound fabric, which will be applicable to the making of quilts, coverlets, and wadding, for purposes of clothing or furniture.*"—November 11.

Isaac Davis, of New Bond-street, optician, for "*improvements in the manufacture of sealing wax, which compounds are applicable to other useful purposes.*"—November 11.

Edward Joseph Francois Duclos de Boussois, of Clyne Wood, Metallurgical-works, Swansea, for "*improvements in the manufacture of copper.*"—November 11.

John Onions, of Field-lane, Barlaston, Stafford, engineer, for "*improvements in the manufacture of certain descriptions of nails, screws and chains.*"—November 11.

James Young, of Newton-le-Willows, chemist, for "*certain improvements in the manufacture of ammonia and the salts of ammonia, and in apparatus for combining ammonia, carbonic acid, and other gases with liquids.*"—November 11.

Isaac Dodds, of Sheffield, engineer, for "*certain improvements in the modes or methods of supplying gas for the purpose of illuminating towns and other places.*"—November 13.

Henry Mortimer, of Frith-street, Soho, gentleman, for "*improvements in covering ways and surfaces, and in constructing arches.*"—November 16.

John Squire, of Albany-place, Regent's-park, engineer, for "*certain improvements in the construction of steam boilers or generators.*"—November 16.

Robert Stirling Newall, of Gateshead, Durham, wire-rope manufacturer, for "*improvements in the manufacture of flat bands.*"—November 16.

John Venables, of Burslem, in the county of Stafford, earthenware manufacturer, and John Tunnicliff, of the same place, bricklayer, for "*a new and improved method of building and constructing ovens used by potters and china-manufacturers in the firing of their wares.*"—November 20; two months.

William Manwaring, of York-street, Lambeth, engineer, for "*certain improvements in the manufacture of sugar.*"—November 23.

Richard Gurney, of Trevinnion-house, Cornwall, for "*a method of cutting wood and incrusting the same in order to present a sure footing for horses and other purposes.*"—November 25.

TO CORRESPONDENTS.

Communications on the Tractive Power of Paddle Wheels—On Atlantic Steam Navigation—and on Steam Locomotion on Common Roads, will appear next month.

The Fourth Report on both banks of the River Hull, and also Mr. Denton's suggestions for a Bill for Drainage of Land, will be noticed in the next Journal.

A Constant Reader.—*The First Volume of Bruff's Engineering Field Work has been published.*

E. *If we can be furnished with Lists of Iron Steamers built by the various Builders, similar to the one of Messrs. Fairbairn & Co., inserted some time back in our Journal, we shall be happy to publish them.*

A Correspondent who wishes to know what is the qualification requisite to be admitted into the Institution of Civil Engineers, had better apply to the Secretary in George Street, Westminster.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," No. 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

The present Number completes the Fourth Volume: the Index, Title-page, &c., will be given with the next Number.

Vols. I, II, III, and IV, may be had, bound in cloth, price £1 each Volume.

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INDEX TO PLATES AND ENGRAVINGS.

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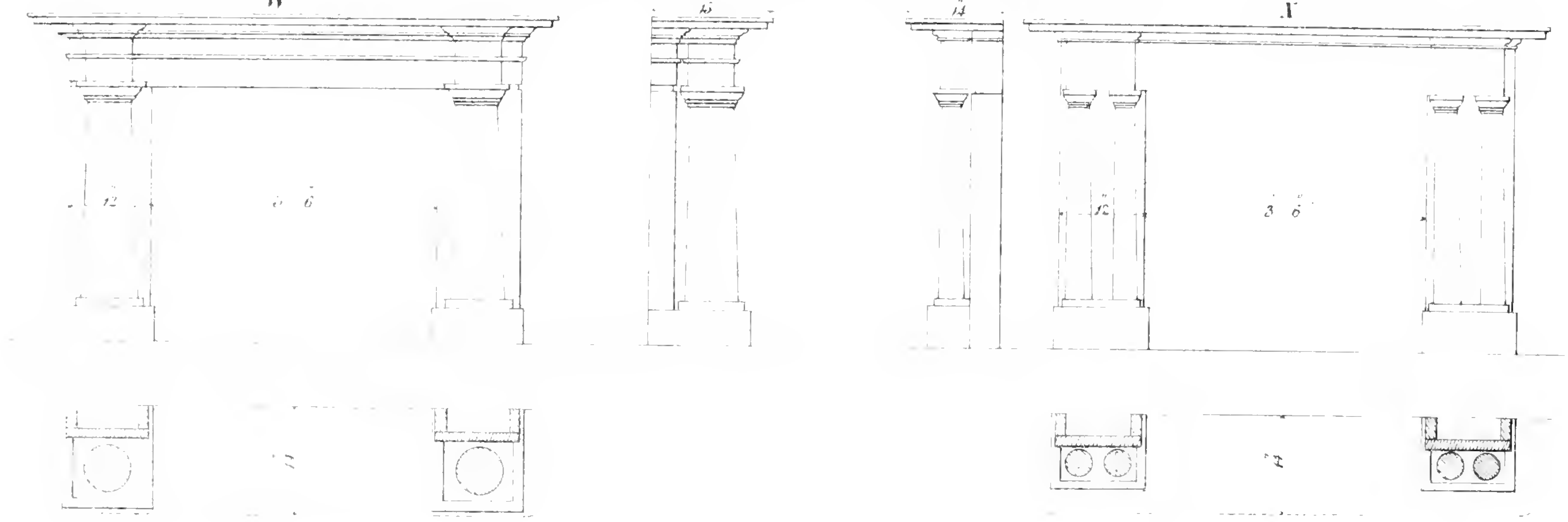

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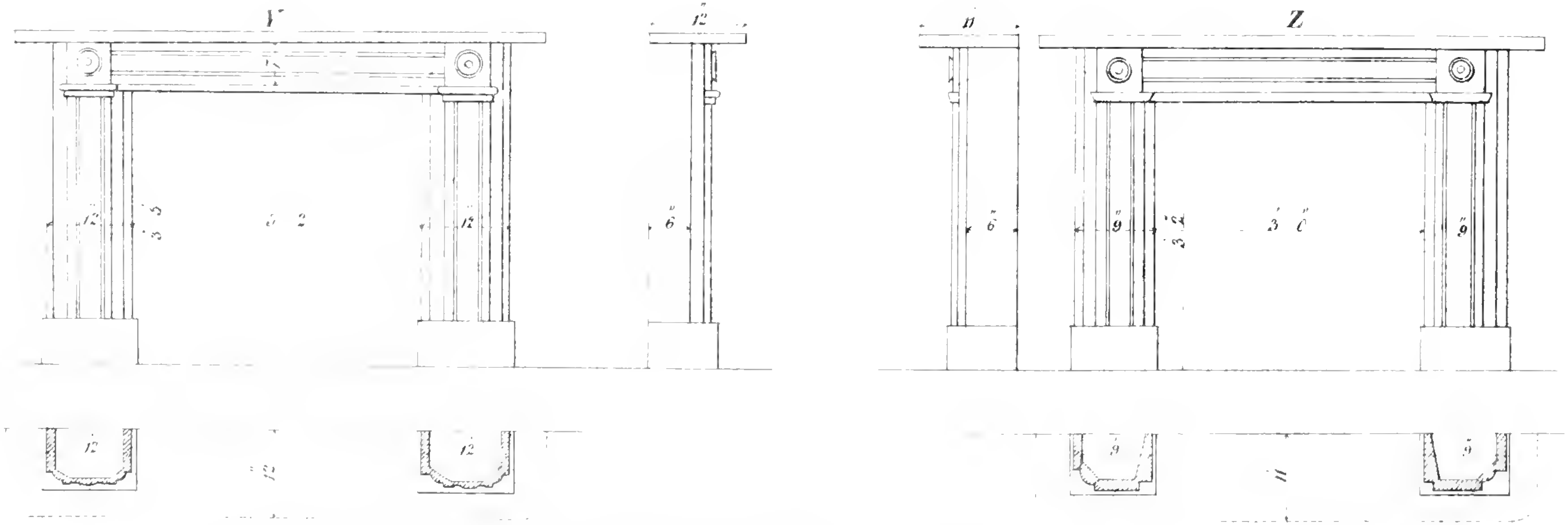

The Proprietors of the above Factory have made extensive arrangements in supplying Chimney Pieces Manufactured by Machinery in a superior manner at reduced Prices.