lated 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 I. 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, Seawards, 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 14th 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. 11, 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.

Samue' 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 Varoc (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 experiments, 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 SELSON.
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 expense 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, if 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 result 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 wheels 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 those 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 $\frac{14 \times 33{,}000}{44{,}000} = 10\frac{1}{2}$ 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 exquantity, 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 4½ 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 Dunhampstead.*" 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 Cavalho" 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 $\frac{1}{10}$ 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 soil; 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 on 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 new 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 ⅞ 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 ¼ 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 $10\frac{1}{4}$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 $\frac{1}{10}$ 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, he 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 $\frac{1}{10}$ of the stroke, but not all the steam, for it had not all entered the cylinder until the piston had travelled through nearly $\frac{4}{10}$ 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 soutern 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 £6,420 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 94 lb. of coals, the lowest 63,650,298 lb., and the average 86,480,018 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 7¾ 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 4½ 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 1¼ 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 7¼ 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 55½ tons.

		£	s.	d.
Cylindrical boilers, 55½ tons at £27	-	1498	10	0
Wagon-head boilers, 7¼ 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 2¾
Average Welsh - - -	8·045	15 2¼
Coke from Gas-works - -	7·908	14 11
Coke and Newcastle small ½ and ½ -	7·897	14 10¾
Welsh and Newcastle, mixed ½ and ½ -	7.865	14 10
Derbyshire and small Newcastle, ½ and ½	7·710	14 6½
Average large Newcastle - -	7·658	14 5¾
Derbyshire - - - -	6·772	22 9¼
Blythe Main, Northumberland -	6·600	12 5½."

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, 1620; 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 instrument 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 2,468 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 approaches, 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 uninclosed 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 inclosed 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, Gueynard, 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 Meneey 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 300,000 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 equa 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 WEIGHT, 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, aad 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 Bury, 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 Brynycairan, 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.

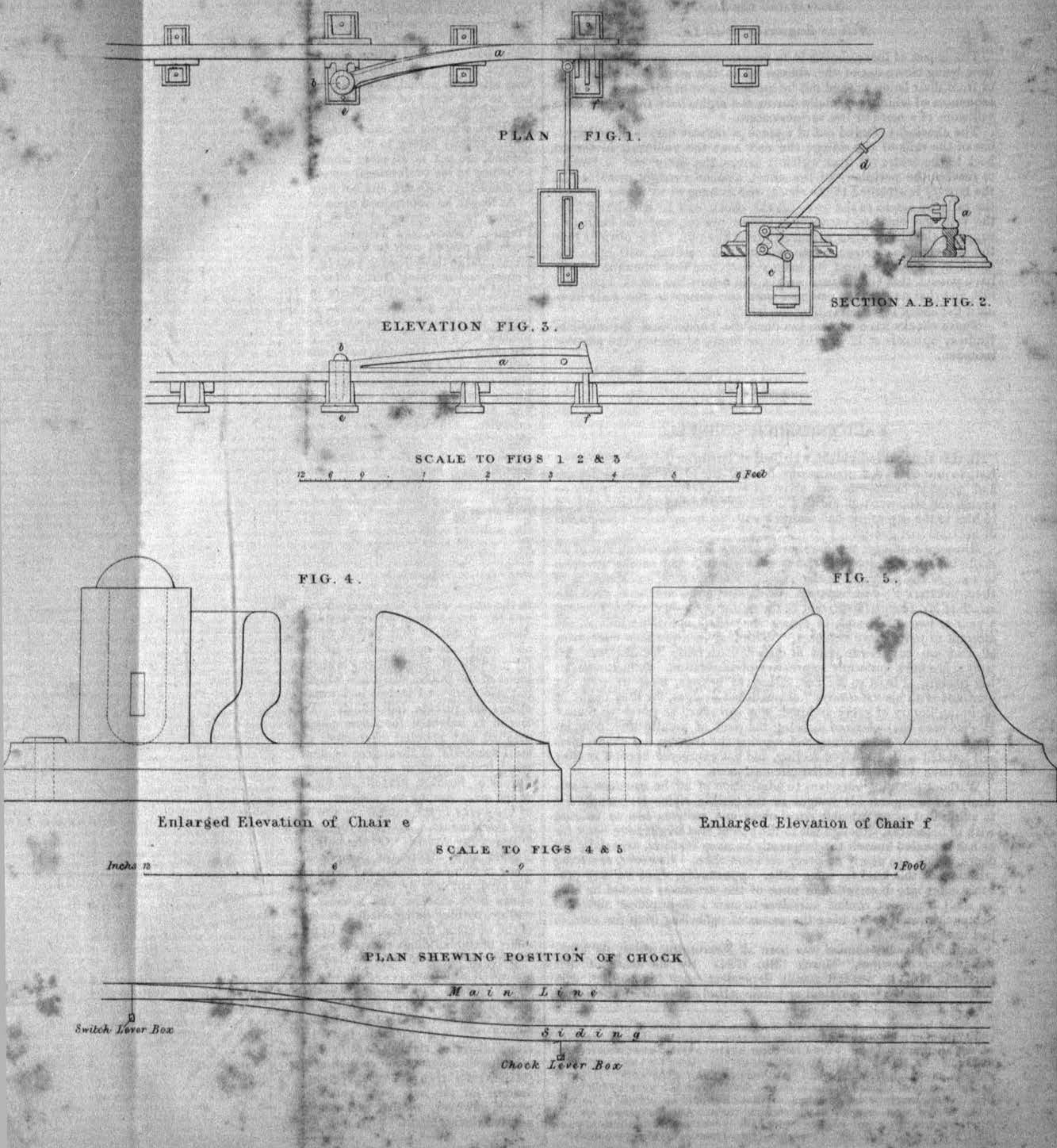
The next number will conclude the fourth volume.

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



J. R. Jobbins, lith.

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 "Entwürfe;" 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, Stüler, Knoblauch, Bürde, 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 (Möbel-entwürfe), and "Entwürfe der Höheren Baukunst," containing designs for the new royal palace, on the Acropolis, at Athens, for which, however, another site was chosen, and Gärtner 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 *Hotel 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 really 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, or 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. Cariotie, Godde, Menager, Chatillon, Gauthier, Le Bas, Nepveu, Leclère, 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 24, 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 iehgenrs.

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 gorgeousness 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 tertiries, 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 train*," 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 $\frac{3}{4}$ 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 $\frac{3}{4}$ 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 importance with $\frac{3}{8}$ 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.

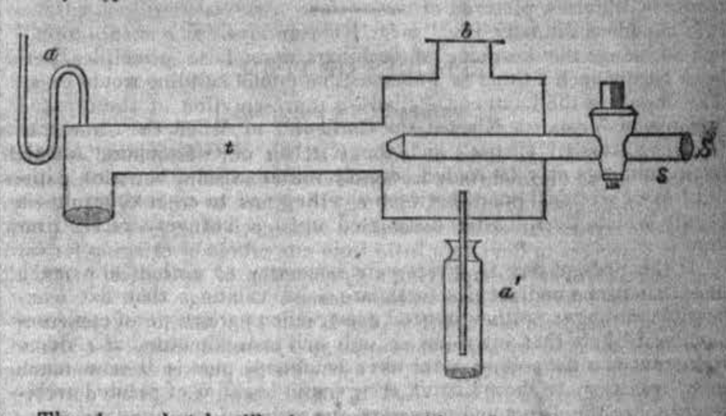
EVAPORATION OF WATER.

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 $9\frac{7}{8}$ nches, 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—if 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.

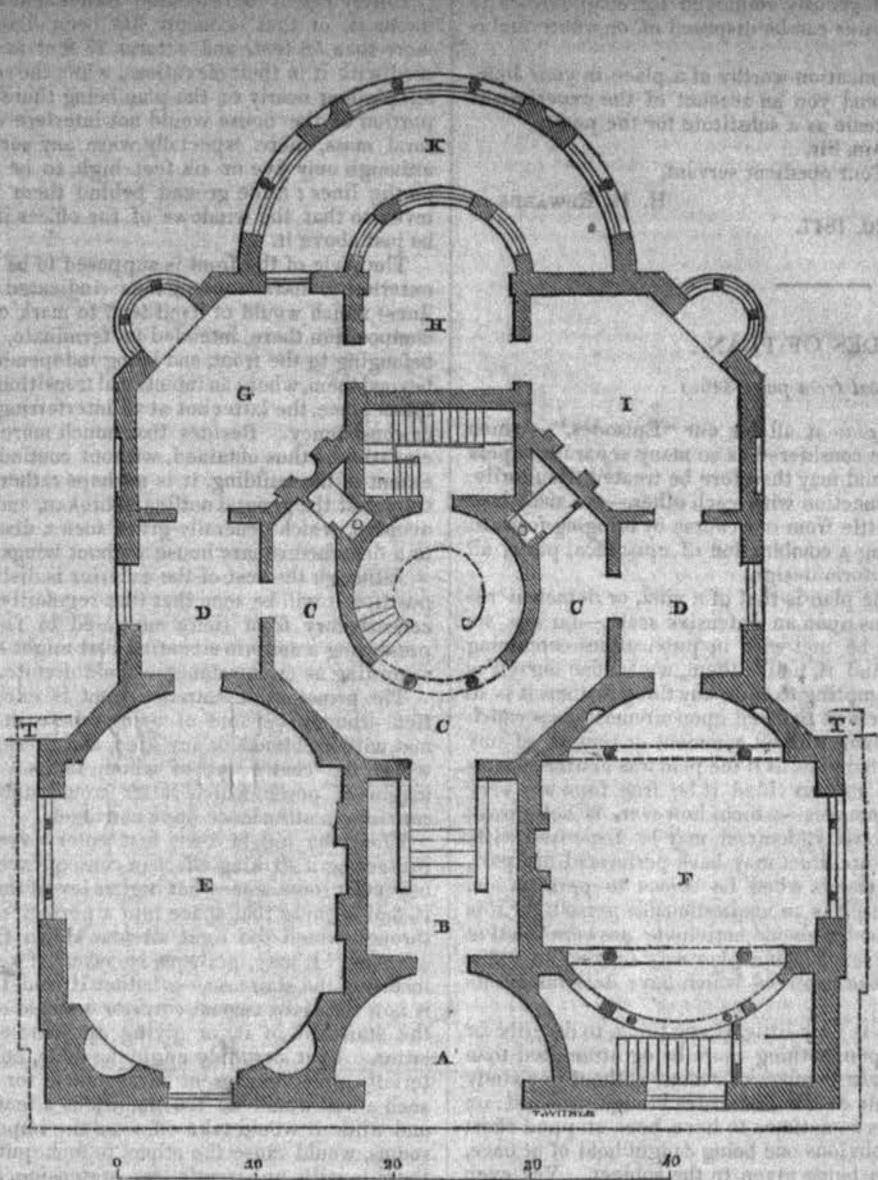
The style of the front is supposed to be Italian, and that part of the exterior to have a cornicione (indicated on the plan by the dotted lines) which would of itself tend to mark out that portion as a distinct composition there intended to terminate, its end elevations obviously belonging to the front, 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



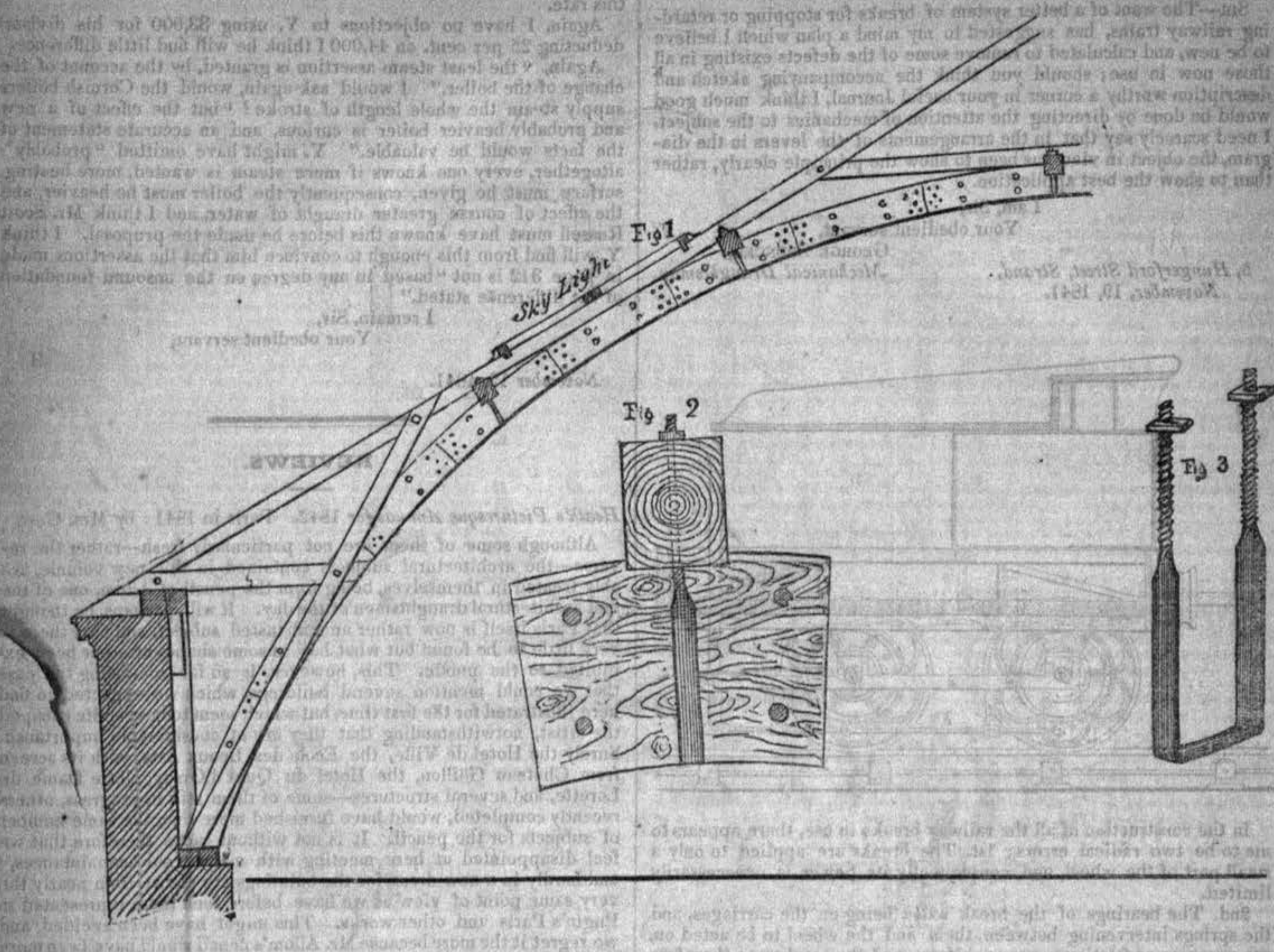
sufficient for the accommodation of a comfortable dinner party. The sideboard alcove is divided from the staircase behind it by a partition carried up about seven feet from the floor, or half the height of the room, forming a screen, surmounted either by dwarf columns or caryatides. Behind this screen 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 wight 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.



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 VALNE,

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.

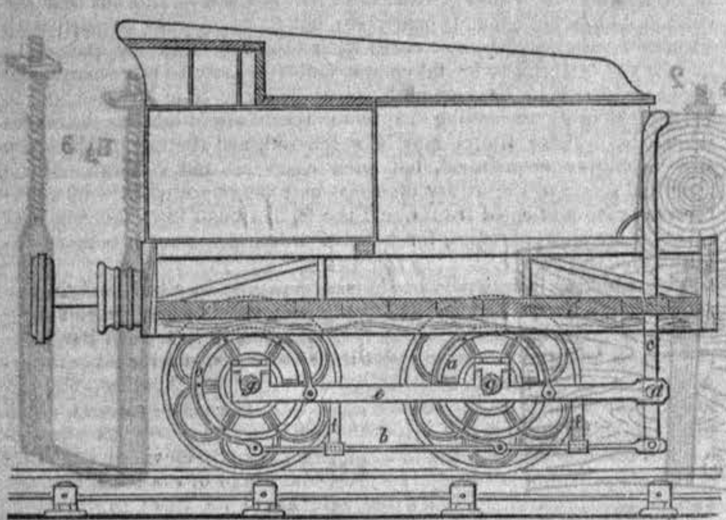
November 22, 1841.

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 beating 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.

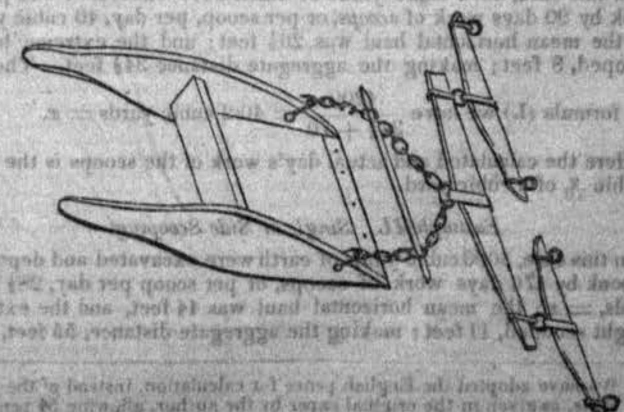
This instrument is particularly well known to canal contractors, much used by them in earth cuttings, and most frequently employed in excavating the trunks of canals, where they are so laid out that the cutting makes the bank, or nearly so; but the *scoop* may be used with success in all excavations of earth where the slopes do not exceed 1½ 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:

$$\frac{\left(\frac{60}{\frac{a}{70}+1}\right)b}{10} = x.$$

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, $$\frac{4200}{a+70} = x \quad . \quad . \quad . \quad \text{I.}$$

And for *side scooping* the general formula will be:

$$\frac{\left(\frac{60}{\frac{a}{70}+1\frac{1}{3}}\right)b}{10} = x.$$

Transforming which, by the rules of algebraic fractions, we have:

In Side Scooping, $$\frac{4200}{a+93\frac{1}{3}} = x \quad . \quad . \quad . \quad . \quad . \quad \text{II.}$$

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:

$$\frac{c}{x} + d = y \quad . \quad . \quad . \quad . \quad \text{III.}$$

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 $\frac{4200}{34\frac{1}{2}+70} = 40{\cdot}2$ cubic yards $= x$.

Here the calculated and actual day's work of the scoops is the same within $\frac{2}{10}$ 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, $28\frac{1}{2}$ 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 $\frac{4200}{55+93\frac{1}{3}} = 28{\cdot}3$ 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 20,032 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.*

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.

* 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.

* 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 4,496 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 $\frac{4}{9}$ 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 this 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 Solà 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.

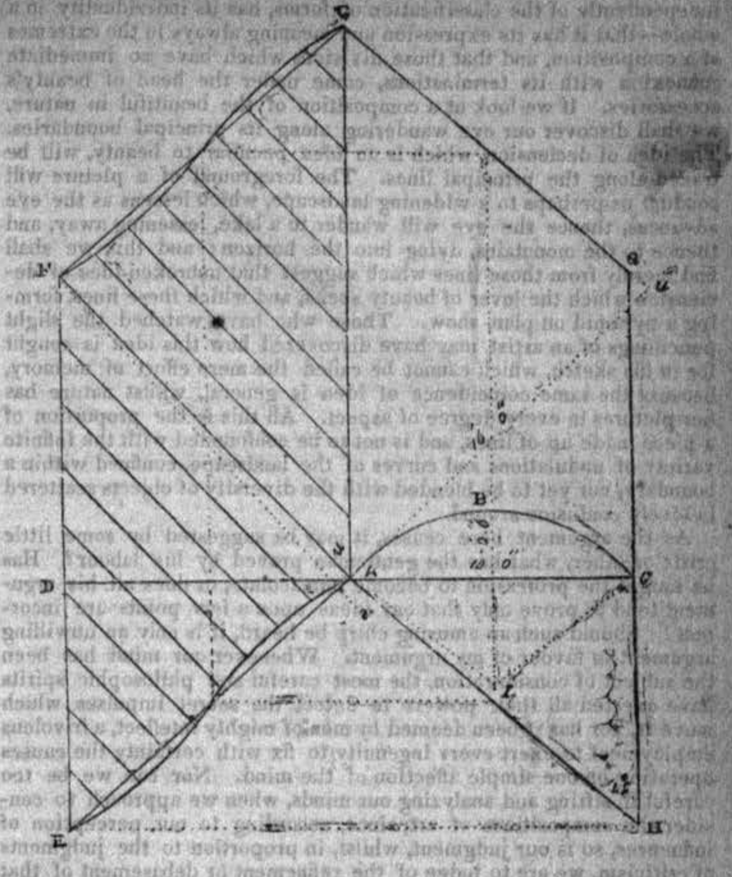
I am, Sir, your most obedient servant,

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 *v* perpendicular to A E meeting it in *v*, and as the point *v* falls between the eighth and ninth point, but nearer to the ninth *v*, 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 opening 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 12½, or 25 feet, and that this is packed into a box 3½ 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.,
GEORGE TOWNSEND.

Yarmouth, Nov. 13.

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 $\frac{1}{540}$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 $\frac{3}{4}$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

$$\frac{\text{Principal focal distance} \times \text{principal focal distance}}{\text{Distance of object from object-glass} - \text{principal focal distance}} = \text{Aberration}$$

$$\text{or} \quad \frac{fc \times cd}{cD - cd} = Ff$$

Now $cD - cd = dD$, then $fc \times cd = Ff \times dD$ and
therefore $Ff : fc :: cd : dD$ and by composition
$Ff \times fc : fc :: cd + dD : dD$ or simply
$Fc : fc :: cD : dD$

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 tct or $t'ct'$, and while at F the angle scs or $s'cs'$; 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 $t'ct'$ is greater or smaller exactly in proportion as the distance of the said staff from the angular point c 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 $tF : rf :: Fc : fc$ and it has been shown that $Fc : fc :: cD : dD$, therefore by inverting $dD : cD :: sFs : tFt$, and since $tFt = sFs + 2st$ then $dD : cD :: sFs : sFs + 2st$, 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 $2st$.

$$\text{Now } dD : cD - dD :: sFs : sFs + 2st - sFs.$$

$$\text{or simply } dD : cd :: sFs : 2st.$$

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,

$$\text{Now } dD : sFs :: cd : 2st, \text{ or } \frac{dD}{sFs} = \frac{cd}{2st}.$$

$$\text{Again } dD : sFs :: cD : tFt, \text{ or } \frac{dD}{sFs} = \frac{cD}{tFt};$$

$$\text{therefore } \frac{dD}{sFs} = \frac{cd}{2st} = \frac{Dc}{tFt}.$$

Now cD and dD may be any quantities whatsoever, and as tFt and sFs vary respectively as cD and dD, therefore tFt and sFs are also variable quantities, and may be of any dimensions; but cd, the principal focal distance, is an invariable quantity, therefore $2st$ is also an invariable quantity, for it varies as cd varies, the variation of which is nothing; therefore, the variation of $2st$ is also nothing, or $2st$ is a constant quantity.

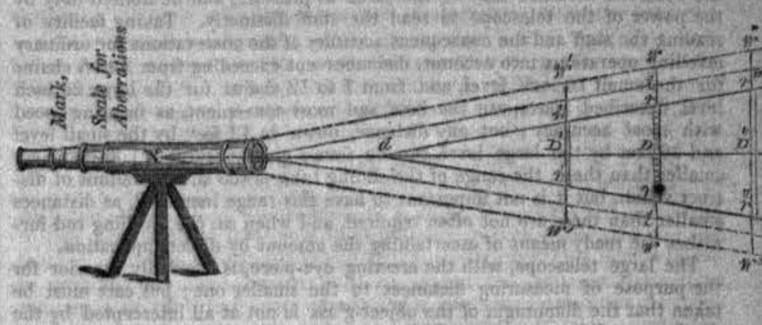
To find practically this constant quantity $2st$ for any telescope and staff, which $2st$, when added to the reading, makes an augmented reading always proportional to the distance of the object from the object-glass of the telescope. First adjust the eye-piece to distinct vision of the cross lines upon 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 fc or cd. (Fig. No. 1.)

Then the instrument being fixed in any convenient open place, measure any distance cD, 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 cD 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 c 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 c, draw ct, ct 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,

$dD : rD :: cD : tD$, now $2rD = rDr$, and $2tD = tDt$, and by transposing, &c., the above proportion $dD : cD :: 2rD : 2tD :: rDr : tDt$, but it has been before shown that $dD : cD :: rDr$, or the reading: to the reading + a constant quantity; therefore tDt = the reading + the constant, and it is equal to $rDr + 2tr$, therefore $2tr$ is the constant corresponding with $2ts$ 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 $\frac{dD}{rDr} = \frac{Xd}{2wr}$, 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 b 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 cd measures 18·5 inches, or 2·33 links, the distance Xc, 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 $1000 - 3{\cdot}6 = 996{\cdot}4$ links from the point d, the reading is 13·80 feet; now here $dD = 996{\cdot}4$, $XD = 1000$, $rDr = 13{\cdot}80$ feet, and it is required to find wDw and the constant $2wr$.

$$\text{Now} \quad dD : XD :: rDr : wDw, \text{ or}$$

$$996{\cdot}4 : 1000 :: 13{\cdot}80 : 13{\cdot}849 \text{ or } 13{\cdot}85 \text{ nearly}$$

and because $wDw - rDr = 2wr$, therefore
$13{\cdot}849 - 13{\cdot}80 = {\cdot}049 = 2wr$, 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 $200 - 3{\cdot}6 = 196{\cdot}4 = dD$, and $196{\cdot}4 : 200 :: 2{\cdot}72 : 2{\cdot}769$ or 2·77 nearly and $2{\cdot}769 - 2{\cdot}72 = {\cdot}049$ 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

* Here it may be observed, that the distance between the object-glass a 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-g'ass 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.

length 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 Xd, 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 $\overline{D-F}$ 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 $\overline{D-F} \times e = F^2$, 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 (18½ 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 distanct 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 ofthe 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 have 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 aud 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.

June 8.—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 71·4, 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 8½ 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 430°, 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.

* Player's Patent.

"*On an uniform System of Screw Threads.*" 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	$2\frac{7}{8}$	$2\frac{7}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{5}{8}$	$5\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{1}{2}$	

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 250 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 796 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 39 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, dovetailed 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 defects 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.

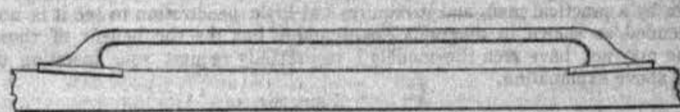
I am, Sir,
Your very obedient servant
Dublin, 18th Nov. WILLIAM BEWLEY.

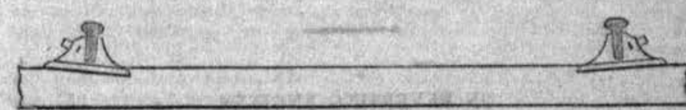
W. B.'s IMPROVED RAIL AND CHAIR.

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 15, 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 disemboguing *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 beating 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 1,402 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 Juggernath 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 4,736r. 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 expense, 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 57,34,223r., 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 4,963,288r. 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 45,000 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 126,000r., 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 15¼ lacs of rupees, the returns up to the end of the year 1840 had been 21¼ 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 Patua 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 architect and the artists to be employed may work not only in conjunction with, but in aid of, each other.

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 to assist, both with information and advice, some department of the Government, which, after mature consideration, should be solely reponsible for the execution of the plan best calculated 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 propose, in conjunction with the architect, the most effectual means of attaining the chief object aimed at by the appointment of the committee, viz., the encouragement of the fine arts of this country. By taking this course, the architect 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 determination by the house to take this opportunity of encouraging the arts, and of associating them with our public architecture, our legislation, our commerce, 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 $4\frac{1}{2}$ 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 tranverse 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 originally 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	4 lb.	14 oz.	406
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. Durance, 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 then 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 rods were 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 Boyes, 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. Whichwed and Walker, of Maidstone. The church about to be erected is on a site, the gift of — Lambard, 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 another new church, to be called the Church of St. Silas. It is to be built in the Norman style of architecture, with square towers, surmounted by octagonal spires, circular windows, and clustered columns. Messrs. Starkie 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. Baunel, 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 LEJUNE, 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 STRILING 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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