may be the degree of attenuation and the nature of the chemical principles or mechanical processes employed to effect it, the groups obtained always show the same elementary composition and capacity of combination, so that their atomic formula is always the same. But polarized light proves precisely the same identity, and M. Payen willingly acknowledges that it was this constant identity which guided and sustained him in his delicate researches.

Shall I venture to say that these indications are in advance of the results of chemistry, and show dissemblances of molecular action in cases of isomerism, to which the science has not yet been applied. There is nothing more rigorously isomeric than an aqueous solution of tartaric acid, brought temporarily to temperatures a few degrees different in close vessels. But polarized light shows that the molecular affections of this solution vary progressively with the degree of the thermometer, and return to the same primitive state when the temperature is lowered to the same degree. Are we not to believe that these variations are accompanied by corresponding chemical changes in the groups, and which would be manifest if we had tests sufficiently delicate to appreciate them?

Finally, to the multiplied examples which might be given of these applications, I will only add that the same mode of observation may often serve to render sensible the temporary modifications which certain substances undergo when they combine with others endowed with a rotary power. M. Peligot may easily prove this, in the different soluble compounds he has formed of different kinds of sugar. Neither will this process be less fit to complete the character of the progressive changes which M. Frémy has effected in tartaric acid, by heat. In general, when we enter somewhat profoundly into the study of bodies, we soon find that they must be subjected to the most varied proof to discover the mysteries of their constitution; and the more different the nature of the processes applied, the more are the characters thus revealed valuable for the purposes of synthesis, on account of the very diverse mechanical conditions under which we may bring them together. Could it have been believed a few years ago, that impressions produced on liquids in motion, by the vibration of a musical instrument, would be the indication most immediately adapted to prove the physical mode by which their flowing is effected?

Ann. de Chem. et de Phys. Sept. 1838.

Progress of Civil Engineering.

The Thames Tunnel.—Copy of MR. WALKER'S Report to the Treasury, on the Works at the Thames Tunnel.

In consequence of several propositions made to the Lords commissioners of her Majesty's treasury, for further means for continuing and facilitating the work, they directed James Walker, President of the Institution of Civil Engineers, to take into consideration the various papers relative to the late irruption of the river, with the special reports from Mr. Brunel, of the works proposed to be carried on at the tunnel, and to report to the treasury his views and opinions on the eligibility and means of prosecuting the work.

"I gave the subjects, (says the reporter), my immediate attention, and was preparing a report thereon, when on the 2nd November, another (the fourth) irruption of the Thames took place, and on the 6th, when I visited

the works of the tunnel, Mr. Brunel, the engineer, and Mr. Charlier, the secretary, requested a postponement of my report for a short time, until they should complete an expected arrangement with the navigation committee of the river Thames, from which they expected increased facility and security. This request I communicated to Mr. Baring, by letter, on the 9th November.

I have since received Mr. Spearman's letter of the 2nd December, transmitting to me, by command of the lords of the treasury, a copy of a letter from the secretary to the Thames Tunnel Company, dated 15th November, together with a report of Mr. Brunel on the present state of the tunnel, and the best mode of proceeding, and also a plan of the works, with a request that I would communicate to their lordships my opinion upon the several points referred to in the papers, previous to their determining on the proposals and recommendations of the company.

Since receiving the above instructions, Mr. Spearman has stated to me the desire to be, that every point, particularly as respects cost or estimate, which I consider of importance in the general question of the tunnel, should be included in my report, so as to bring the whole fairly under the consideration of their lordships.

That Mr. Brunel's different reports in which the same recommendations are repeated, may be brought to their lordship's recollection, I shall give a short abstract of the mainpoints in the order of date.

In his report of 2nd May, 1837, Mr. Brunel ascribes the difficulties which had retarded the progress of the tunnel for the last five months to the excessive rains of the preceding autumn, liquifying the ground between the ceiling of the shield and the river, and causing it to run into the works; he states that this has been augmented by his being deprived of the pumping-well and drain from Wapping, which is stated to have been originally intended, and to have been considered the most efficient means of drainage, particularly as the dip of the strata is to that side, and that before any satisfactory progress can be calculated on, the proposed pumping-well, with a drain or drift-way, should be made, but that a preferable plan would be to sink the fifty-feet shaft for the foot passengers' descent, which would, he considers, be a better means of drainage, and would give employment to the workmen when not in the shield. The fact of the pumping at the entrance of the London Docks having dried the wells in that neighbourhood, is adduced as a proof that a pumping-engine on the Middlesex side would diminish the land-springs in the tunnel.

Mr. Brunel estimates the expense of the shaft, including the steam-engine, pumps, &c. at 6,844*l.*, and the pumping-well alone, at 2,690*l.*, independent of the drift-way or drain, which he calculates at 4,310*l.*, making together 7,000*l.*, which sum he presumes would be saved by forming the shaft, rather than the well, at the present time, exclusive of keeping the workmen and establishment employed, and thereby reducing the amount which is now charged to the tunnel account. He also mentions the impregnation of the water with sulphurated hydrogen, which has proved very injurious to the health of the workmen, as another reason for making the drift-way, as it would be the most effectual means of drawing it off. The report states, that "the fact of sixteen feet of the tunnel having been completed under the described difficulties, is a proof that it can be accomplished, though, owing to the disadvantages, at an enormous price, and that it never could be intended in the conditions of the treasury that he should be deprived of the means of completing the work at the estimated cost,"

Mr. Brunel's report, dated 9th August, 1837, recapitulates the substance of his previous report, and adduces the successful result of pumping-engines and drift-ways erected for the purpose of taking off the land-springs that impeded the formation of the Kilsby tunnel in the line of the Birmingham railway, as a proof of the good effect that would be felt in the works of the Thames tunnel by a pumping-engine on the Middlesex side. He states also, as an argument for the works he proposed in his former report, the importance of giving the disturbed and artificial ground time to consolidate, and now proposes, on the completion of the Middlesex shaft, to commence the tunnel on that side also, with a view to greater expedition and economy, and to keep the full complement of men more regularly employed by having the two ends to work at. This, it is stated, would reduce the cost of conveying the men, materials, and excavation to the shaft on the Surrey side. In this report Mr. Brunel further states, that as soon as the plan he has proposed is in satisfactory operation, the formation of the carriage roads might be commenced simultaneously with the tunnel, and that by the various means he now proposes, a saving might be effected in the time, of four and a half years, which, in my report of April 1837, I considered requisite for the completion of the tunnel and approaches, and that, consequently, there would be an earlier receipt of toll and a saving of current expenses and machinery to the amount of 15,000*l.*, by the works being completed one year and a quarter within the time I had calculated. Various accounts and calculations in proof of his several positions are appended to this report of Mr. Brunel, and an estimate that, to carry on the works as he recommends, the sum of 94,000*l.* will be required during one year from August 1837.

The lords commissioners of Her Majesty's treasury having refused their assent to the tunnel being begun on the Middlesex side, Mr. Brunel in his report, dated 7th September, 1837, repeats the other recommendations of his former reports.

The last report of Mr. Brunel that is referred to me, is dated 15th November, 1837, the fourth irruption of the Thames having taken place on the 2nd of that month. In this report he considers the third irruption (that of the 23d of August) as not having been unfavourable in one point of view, as it would enable substantial ground to be substituted for the loose silth that had worked into the tunnel by the irruption; in proof of which he states that the work done before the third irruption cost 900*l.* per lineal foot, while what was done between the third and fourth irruptions cost only 630*l.* The former recommendations and arguments are repeated, and in addition it is now stated that the fourth or last irruption was caused in a great degree by the part of the tunnel then in progress being under the portion of the river chiefly used for navigation, and that the depth being small, the artificial bed of the river, or roof of the tunnel, was liable to be disturbed by passing vessels. This, Mr. Brunel now proposes to remedy, by deepening a part of the river where the tunnel is formed, moving some of the ships in the tiers near the tunnel from the northern to the southern side of the river, according to a plan which accompanies his report, throwing the space which is required to be kept clear for the navigation from the north side towards the middle of the river, over where the tunnel is formed, so as to leave the space which is in advance of the works free for tunnelling operations, and then substituting a thicker roof of clay and gravel raised above the present level, to which, from the navigation not being then over that part, there would not be the same objection as at present. The thicker roof

Mr. Brunel proposes to make 100 feet in length, or in advance of the shield, and 100 feet on each side of it. He calculates on a great saving in the end from this artificial covering, which he estimates at 1,800%, and ascribes much of the late trouble and expense to the passing ships, and the want of a sufficient thickness in his roof, which the navigation prevented his having.

The reports are drawn up in great detail, and the above abstract is to be considered not as a substitute for them, but only as bringing the leading points to recollection in one view, without the repetitions which the reports themselves, being of different dates, naturally contain.

It is now my duty to state my opinion; which is, to recommend Mr. Brunel's proposal to be adopted, as the most economical and creditable way of executing the works, if it be the determination that the Thames Tunnel (a work which for many years has attracted much of the public attention in this, and still more in other countries, and upon which upwards of 80,000% of public money has been advanced,) shall be completed, without making cost an element in the question. I would then even advise more effectual works in front of the shield than Mr. Brunel's description and estimate of 1,800% contemplates; for if the work is to be considered a national or government work, a repetition of the danger, the late irruptions, and the enormous expense of the work, would be discreditable, and, as it may be, it ought to be prevented. In addition to Mr. Brunel's proposals, I would recommend, after the removal of the clay that has lately been thrown in, and a portion of the silt, that two rows of close whole timber piles should be driven between where the ground begins to rise and the present shield, one row on each side of the line of tunnel, with space between sufficient for the shield to travel, and to as great a depth as they can be conveniently driven, the heads being level with low water. These, with a return of shorter piles at the end, would form a dam against the silt. The piles being driven, I would continue the dredging of the silt in the space enclosed by the piles, and then fill up with clay, gravel, &c., as at present, to a sufficient height, and afterwards give the mass time for consolidation before attempting to advance the shield, which, in my report to the commissioners for the loan of exchequer bills, I stated to be an essential element for success in the undertaking. In the progress he has made through very bad strata, Mr. Brunel has fully tried and proved the great power of his excellent shield; but the strata, rendered worse by the irruptions and the causes assigned by Mr. Brunel, are now too bad for even the shield to overcome. By the substitution of good artificial soil to work through, and keeping the silt, or sand, back by the piles, there would be much less difficulty or danger; and with proper precautions, my decided opinion is, that the tunnel may be completed notwithstanding the late irruptions, and with comparatively little difficulty or risk.

Here the question naturally presents itself, at what cost? and to answer it with the probability of accuracy, is still very difficult.

The amount of the company's capital expended previous to any advance of public money was 180,000%.

On the 27th February, 1837, when	64,600
received from the commissioners for the loan of exchequer bills	
had been expended, I estimated the addition then required to complete, at	310,000

Making, exclusive of the company's capital	£ 374,600
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Between the 27th February and the 2nd November, 19,300*l.* have been expended, making 83,900*l.* of public money expended to the 2nd November, but the quantity of work done with the above 19,300*l.* is only 19 feet 6 inches, making, (inclusive of 1,400*l.* for pumping, excavating, and claying, after the third irruption,) nearly 1,000*l.* per foot, which very much exceeds all previous estimates, and proves what I stated in evidence before the select committee of the house of commons, that no prudent man would commit himself to the accuracy of an estimate of this work, while it shows also the impolicy of attempting to drive on the shield through the present bad soil without a sufficient covering, and time for consolidation.

In the present situation I consider that the sum of 150,000*l.* should be taken as the estimate for completing the tunneling; and that the shafts and other works remaining to be done, together with the purchases, should not be estimated under 200,000*l.*, making, with the 84,000*l.* of public money already expended, and the company's capital previously expended, a total of 614,000*l.* for the estimate of the work, or upwards of triple the original estimate, and this is allowing but a moderate sum for contingencies, which have heretofore been very heavy.

I have estimated the great descents at double Mr. Brunel's estimate, and yet I have, from the nature of the work, as much doubt as to the sufficiency of that sum as of any other item in my estimate.

If, however, in place of determining to complete the tunnel without reference to cost, which the foregoing observations suppose, the lords of the treasury resolve, as heretofore, to confine their operations to the advance of the tunnel, so as to remove any doubt of its getting through, before they sanction a further heavy outlay, then, although I agree with Mr. Brunel that the pumping-well or the shaft, with the drift-way, or drain, would lessen the springs, I do not by any means think them so essential to the progress of the work as to agree in recommending their being proceeded in at present. Up to the time of the second irruption, in January 1828, the works were under the uncontrolled management of the directors and engineers, and during that period nothing had been done on the Middlesex side with a view of draining the water from the tunneling, although it had then advanced to the middle of the river, only 155 feet having been done since, but in the report of 1831, the drift-way or adit is proposed and estimated, with the pumping-well, at 6,000*l.* Mr. Brunel informs me that the drainage in the tunnel is now very small, and the short time in which the water after irruptions has been taken out, proves that the present pumping-engine is fully equal to the work.

More rain, by two inches, fell during the last six months of 1836 than of 1835*, an increase, but not such as to cause a very important difference in the workings, which I ascribe almost entirely to the ground towards the Middlesex side being of a looser and more sandy and silty nature than towards the south side; this, it has always been said by the Trinity officers and others acquainted with that part of the river, would be found to be the case; so that, although the spring-water has been an evil and an hindrance, the Thames water has been another and probably a greater, and is the present enemy, which makes the cases of the London Dock or the Kilsby Tunnel parallel to a certain extent only. It is not in preventing the communi-

* The quantity of rain that fell in the last six months of 1835 (as kept at the Royal Society's rooms) was 10½ inches, and in the corresponding period of 1836 it was 12½ inches. In the same period of 1834, a very dry year, it was only six inches.

cation with the spring, but with the river water, that the artificial roof of clay, &c., has been useful.

I agree that the air for respiration would be improved by the drift-way, and probably the present air-pump, which is worked by the steam engine, rendered unnecessary; but this pump, ingenious as all Mr. Brunel's applications are, appears to completely answer the purpose, and would probably be found quite as effectual in abstracting the sulphurated hydrogen, as a drift-way at the bottom would be.

I cannot agree as to the saving of expense by the shorter distance to the Middlesex shaft; the difference of distance in the present situation of the shield would be only seventy yards, and as an excellent railway is laid, and machinery attached for working it by the steam engine, I am sure that the conveyance of the excavated soil along the bottom of the tunnel to the low ground on the Surrey side must be at least as cheap as to the Middlesex side, where the ground is chiefly covered with buildings, and does not require to be raised, and that, as a passage to and from their work, the workmen would generally prefer the spacious lighted tunnel to a drift-way, until the difference of distance is much greater than at present.

That the well, or shaft, on the Middlesex side would give employment to the miners and other workmen when they cannot be employed in the shield, and thus lessen the amount now charged to the tunnel, I entirely agree; but my opinion at the same time is, that they may be fully employed in securing the ground in advance of the shield, according to Mr. Brunel's plan, or with the additional piling, such as I have suggested. It appears to me that sinking the shaft, driving a drift-way, making a new shield, and proceeding from the Middlesex side, would amount to a committal to go through with the undertaking, and ought not to be begun until that, as a previous question, has been determined.

In stating this, I am in some measure influenced by the opinion that Mr. Brunel's estimate for the works on the Middlesex side is too low. He estimates the pumping-well and drift-way at 7,000*l.*, and the shaft-engine and pumps at 6,844*l.*, and gives a decided preference to the shaft. Now the shaft on the Surrey side is stated in the account to have cost 20,000*l.*, and evidently the drift-way, 4310*l.*, should have been added to the shaft, as to the well-plan. The Middlesex shaft may, and probably will, be less expensive than the Surrey one was; I think it unsafe to trust calculation against experience, so far as to take one-third of the actual of the Surrey, as the estimate for the Middlesex, shaft.

Of the propriety and importance of changing the channel for the passage of vessels, from the part of the river in front of the shield which has yet to be tunneled through, over to the part which is tunneled, and forming a body of compact gravel and clay in front of the shield, in the way Mr. Brunel proposes, to a greater thickness than is now compatible with navigation, there can be no question; and I am glad to learn, by a letter received from Mr. Charlier, that the Navigation Committee have agreed to the proposal, and as Mr. Brunel considers that this will remove much of the cause of the late irruption, by enabling him to have a better covering of clay, and preventing vessels grounding upon the artificial bed, and estimates the necessary work at only 1,800*l.*, I have no hesitation in recommending to the lords of the treasury to sanction it, even with the addition I have proposed, should Mr. Brunel be disposed to adopt it. I think the expense of the piling and clay may be taken at about 10,000*l.*, and I feel assured that, if the completing of the tunneling be the object, this outlay

will be more effectual, and much less in amount, than proceeding with the works on the Middlesex side. From the length of the river proposed to be covered with clay, if done according to Mr. Brunel's plan, being three times greater than with piling suggested by me, I think the difference of expense of the two plans would be small.

Having now given my opinion on the various points that have been referred to me, I would beg to add that, as the Thames Tunnel is Mr. Brunel's work as respects design and responsibility, any measure that may be proposed for executing the work should, in my judgment, have his approval. If that approval is refused, unless the lords of the treasury will consent to works which exceed the amount they have yet thought proper to agree to, almost any course would be better than letting the complaint be repeated, "that the engineer has been deprived of the proper means of completing the work at the estimated cost." (Signed)

JAMES WALKER.

December 1837.

Repertory Pat. Inv.

A Summary View of the Progress of Architecture in Britain during the Year 1838; with some Notices relative to its Advancement in Foreign Countries. By J. C. LONDON, F. L. S. &c.

In conformity with the plan first adopted in our Third Volume, we proceed to give a short notice of the progress made in architecture in Britain during the past year (1838); though we fear that our readers will find this notice little more than the echo of our summary for 1837. The truth is, that, in drawing up an article of this kind, there is no medium between seizing on a few leading features, and remarking on them, and recapitulating an immense number of details, already given in the course of the volume for the current year. The latter plan is not consonant with our views of what such an article ought to be; and though, as we have just hinted, it may be difficult to discover any grand architectural feature to characterize 1838, yet we shall proceed with such as we can find; hoping, at all events, that the brevity of our article will be some apology for the absence of higher qualities.

If the existence of a general spirit for architectural improvement can be characterized as an architectural feature, this spirit may be safely affirmed to be on the increase, not only in London, but through all the provinces. In London, there is not a house rebuilt, that is not erected in a superior style to what it was before; and the renovation of all public buildings is, in general, effected in a very superior style. This system of improved renovation was first rendered conspicuous in the public-houses, and it has since been displayed, in a striking manner, by the banks and the insurance offices; and, more or less, by the shops, in all the principal streets. The employment, in Regent Street and Bond Street, of the Louis XIV. style in shop fronts is one of the latest improvements in this department; and, in combination with the immense panes of plate glass now used for shop windows, and accompanied by rich gilding on a pure white ground, it has a striking and most magnificent appearance.

The introduction of Roman cement, about thirty years ago, has been the foundation of much of the improvement which has taken place in the elevations of street architecture. During this year, and the preceding, a new cement for roofs, terraces, and roads, has been introduced, the basis of which is bitumen; but, whether this will lead to any great change, either in buildings, by the introduction of flat roofs, or in streets and roads, by becom