

THURSDAY, JANUARY 13, 1870

## GOVERNMENT AID TO SCIENCE

IN our present issue will be found a letter from Mr. Wallace on Science Reform, a subject which we lately brought before our readers, and which is attracting, at last, the attention which its immense importance demands.

We have the greatest respect for Mr. Wallace, and therefore willingly give him the opportunity of stating his views, though we entirely dissent from them, and though we regret to see such a question as this dealt with in what we must describe as a narrow spirit calculated to win only popular approval. Mr. Wallace's letter opens with a denunciation of the Education movement as a madness of the public mind, and with an imputation upon the Science Reform movement as a scramble for the loaves and fishes. It is only consistent with such an exordium that the benefits of Science should be depreciated, and that its cultivation should be spoken of as a matter more of personal than of national concern.

"The broad principle I go upon," says Mr. Wallace, "is this—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not available for the benefit of all." And further on he writes: "I maintain that all schools of art, or of science, or for technical education, should be supported by the parties who are directly interested in them or benefited by them." We understand Mr. Wallace to mean by these and many similar passages, that the main result of cultivating Science is merely the gratification of those directly engaged in the pursuit, and that they who do not take this personal interest in it derive little or no benefit from it; and hence, that it would be unjust to tax the bulk of the community to enable a few individuals to indulge their philosophical tastes. If that is not the position which Mr. Wallace desires to take up, we must declare our inability to understand the letter before us; if the position be tenable, we need hardly say that no greater error can be committed than that of seeking aid to Science from the State.

But is it tenable for a moment? Is it really necessary to tell any educated man of the nineteenth century that science, art, literature, with one or two other matters, are simply civilisation; and that civilisation affects, not particular classes, but whole communities? To confine ourselves to our own province, Science, does Mr. Wallace really believe that the discoveries of chemists, naturalists, astronomers, and physicists do not directly benefit even the ignorant masses who cannot appreciate them? Does he know of a single class, we might say a single tax-paying being in England, who does not derive direct advantages from contrivances and processes which place at his disposal properties of matter and laws of nature unknown to uncivilised people? The material results of scientific labour, such as superior clothing and dwellings, more varied food, better medical and surgical appliances, sanitary improvements, easier locomotion, are accessible to all in proportion to their means, however ignorant they may be of the scientific principles to which they are indebted for them,—as accessible to them as to the very philosophers by whom those principles were discovered and applied. Where, then, is the injustice of taxing all

classes, in proportion to their means of commanding the results of science, for advantages which, if not so taxed, they would obviously gain at the cost of others? We are surprised to find it necessary to insist on truths of so elementary a character.

Justice to the taxpayer may be a good electioneering cry, but in such a discussion as the present it will command no hearing. The question for us to consider is whether the taxpayer shall possess greater material advantages than those he now enjoys, and by what agency they may be most efficiently conferred on him: whether, as a nation, we shall strive for a still higher civilisation, and how it is to be attained: whether these objects will come to us unsought, or whether, as a nation, we must exert ourselves vigorously and systematically to gain them. The resulting benefit to the taxpayer will, we need not doubt, far exceed the price he pays for it.

At present, the British taxpayer contributes to the maintenance of a Royal Observatory, of a School of Mines, of a Museum of Natural History, of a Museum of Art, of an Ordnance Survey. The advocates of the *status quo* are bound to show, not merely that catalogues of stars, collections of minerals, animals, statues, mosaics and paintings, and elaborate maps of the kingdom are useful to the taxpayer, but that no other institutions can be added to these with advantage to him, and that those we have named have attained to absolute completeness and perfection, admitting of no further development or improvement. The existence of these institutions settles, once for all, the principle that it is just to tax the community for Science. If not, abolish them. But if taxation for these particular objects be just—which even Mr. Wallace does not deny—then the question whether there are not other objects that should be added to them is one that may fairly be asked.

The examination of this question involves the passing in review of all existing, and all possible, scientific institutions, in order to select those which are properly matters of national concern; the principle of selection being that the nation should charge itself with those only which have the two-fold character of general utility and of being beyond the means of individuals to maintain; it also involves the consideration of the mode in which the scientific affairs of the nation should be administered.

A recent article in the *Pall Mall Gazette* powerfully exposes the failure of local, as contrasted with central, administration. The principles so ably contended for by our contemporary are perfectly applicable to the business of science. The time indeed is gone by for declamation against centralisation. The bugbear of the past has become the necessity of the present. Armies, fleets, railroads, telegraphs, commerce, literature, enterprise in every form, even well-ordered private households, as pointed out in the article to which we refer, are all examples of centralisation—and the tendency is daily to add to the catalogue. It might have been better that each man should suffice for himself, but as a matter of fact he does not. He relies on co-operation for the attainment of objects which he cannot compass alone, and however small the number who so unite for a common purpose, one usually directs the operations. What is true of individuals is true of a nation. Nothing that concerns the well-being of the community can be, or is, left to the

chance efforts of individuals; an organisation is formed with a directing, a centralised authority, to which the whole body defer.

This is now wanted in England for Science, which cannot be cultivated without system, nor can it be governed without system. In a former number of this journal an article from the pen of Prof. Roscoe gave an interesting picture of the scientific organisation of Germany, which may be taken as typical of the Continent. Their arrangements, which carry Government intervention to a point not as yet contemplated by anyone in England, so far from having the deadening effect imputed to Government aid, has produced in large numbers men of the highest attainments and the largest and most original views, and is developing a continuity of results of the greatest practical and theoretical value. The physical education and intelligence of the people is confessedly ahead of that which the same classes in England can boast. The arts in which we once justly claimed pre-eminence are in many instances now more advanced with them than with us mainly because the principles on which they depend are, more assiduously studied, and the artisans by whom they are practised more thoroughly instructed by them than by ourselves. Many branches of trade in England already painfully attest their superiority. As a matter of fact, individual enterprise, which it is so easy glibly to pronounce the incarnation of vigour, has not borne the fruit at home which Government support, with its supposed emasculating tendency, has yielded abroad.

Are we, then, to fall back in the race of nations, to see our trade and our manufactures dwindle away, and our naval and military systems take second rank, because there is an apparent noble independence in the attempt to do single-handed what single hands are proved incapable of doing? We assert that, other things being as nearly equal as variations in religion, customs, and form of government will admit, the degree of cultivation of Science by nations will ultimately determine their places in the human family. No nation on earth has a greater abundance of natural resources and of accumulated wealth than we; no people have higher gifts or nobler aspirations; none need less fear despotic interference from its Government; no nation, therefore, is better qualified to carry out a system which has proved so successful in less-favoured countries.

The question that presses for decision is, What shall we call on the Government to contribute to scientific advancement, and in what manner shall the scientific administration of the future be constituted? The present Government is ready, we doubt not, to perform its part, if only the necessity be shown by competent testimony to exist. It is the duty of men of science, who alone can speak on the subject with authority, to give this testimony, and to help the Legislature to place on a footing worthy of a great nation a department of its duties which has hitherto been, to a most injurious extent, overlooked.

#### THE THAMES SUBWAY

SEVERAL attempts have been made to pass under the Thames. The chalk and alluvial deposits of the valley at Gravesend would even now offer formidable, if not insurmountable, difficulties to the attempt, once made, to tunnel through strata with water sources so un-

manageable. The Thames bed at Limehouse had hidden dangers, which, however, did not succeed in stopping the bold attempt, made some forty years since, to pass beneath the river—an attempt carried in fact to a successful issue in spite of innumerable difficulties, but at an overwhelming expense. The skill and ingenuity displayed were equal to the occasion, but the object attained was not commensurate with the magnitude of the work, and for years it served rather as a warning than an example to be followed.

A better geological knowledge of the Thames valley has, however, been gradually acquired during the last half-century; and it has become evident that while some parts of the valley present the greatest difficulties to the execution of any such work as a tunnel under the river, other parts present conditions singularly favourable for such works. It is found that the chalk *e*, Fig. 2, which disappears at Croydon and reappears at Watford, passes under London at a depth of from 200 to 300 feet; that next over the chalk come beds of sand, shingle, and clay, from 80 to 100 feet thick taken together, *c* and *d*; next above these is a single massive formation of clay, in round numbers from 100 to 200 feet thick under London, and acquiring a still greater thickness—as much as 450 feet—at places not far distant. This clay is so compact and tenacious, that, except in a few places, it is perfectly impervious to water. The various railways in the neighbourhood of London, as at Primrose Hill, Copenhagen Fields, Norwood, and elsewhere, show how readily tunnels can be made through it. It has also been ascertained that this clay, known to geologists as the London Clay, though thin and uncertain at Limehouse, dips westward from that place and gradually acquires a greater thickness, until at London Bridge it forms a mass 120 feet thick. It therefore became evident that while, at and below Limehouse, any tunnel passing under the Thames would have to pass through the soft and permeable beds of sand and shingle lying between the London Clay and the chalk—beds charged with water—forming in fact originally the great water-bearing beds under the London Clay at London, and therefore almost impassable to any tunnel under the Thames; above Limehouse, and thence to London Bridge, the gradually increasing mass of London Clay presents ground more and more favourable for the execution of such a work. If a place could be found where, on the one hand, without going to too great a depth, the alluvial beds on the surface and any accidents in the Thames bed itself, and on the other hand the beds of sands and shingle below the London Clay, could be avoided, while at the same time the intermediate London Clay was thick enough to allow of the passage of a tunnel and for a sufficient thickness of roof and floor, it was clear that at such a place the conditions for the construction of a tunnel would be as favourable as could be desired.

The first to apply this knowledge was Mr. P. H. Barlow, C.E., F.R.S., who fixed upon a spot intermediate between London Bridge and Limehouse (where the thickness of London Clay must be about 80 ft.), and at a sufficient distance below London Bridge to render an underground passage of the Thames a work of great public utility. A space of vacant ground near the western entrance to the Tower was obtained from the Crown; and on the Middlesex side a small wharf offered sufficient width for the tunnel to