

THURSDAY, MAY 14, 1874

THE SCIENCE COMMISSION

IT would be difficult, we think, to overestimate the value of the evidence brought together in the second volume published by the Science Commission. The first volume dealt mainly with the diffusion of knowledge; the second is concerned mainly with the advancement of Science. The Commission has done good service in bringing before Parliament and the country the carefully weighed opinions of men of the highest mark in all departments of Science on subjects of the first importance, not only in their bearing on the advancement of Science but also on some of the best interests of this country. We propose to show the general bearing of the evidence contained in the volume on some of the questions on which the Commission sought information, omitting all opinions of our own.

The unanimity of opinion among the witnesses examined—and their number is large—as to the duty of the State in the matter of Abstract Science is striking; without exception, so far as we have been able to examine the evidence, the opinion is unanimous that it is the duty of the State to encourage original research in Abstract Science. As might naturally be expected opinions vary as to the method which the State should adopt in carrying out this duty, but that some action ought to be taken by the State in this direction is the all but unanimous conviction of the best men in all departments of Science. We need only mention in this connection such names as those of Lord Derby, Lord Salisbury, Sir Stafford Northcote, as statesmen, Sir Wm. Thomson, Dr. Joule, Dr. Sanderson, Col. Strange, Mr. George Gore, Dr. Carpenter, Mr. T. H. Farrer, Prof. A. W. Williamson, Dr. Frankland, Mr. E. J. Reed, General Sir Edward Sabine, Prof. Balfour Stewart, Prof. Owen, Admiral Richards, Dr. C. W. Siemens, Mr. P. L. Sclater, Dr. Hooker, Dr. De la Rue, &c., to show the weight and comprehensiveness of opinion on this point, and that it is held not only by men concerned solely with Abstract Science but also by those concerned with some of the most important practical applications of Science.

Of course the principal way in which the State can aid scientific research is by granting money for the purpose; as to how such a grant ought to be applied various opinions are offered by the witnesses, each witness, as a rule, naturally looking at the matter from the point of view of his own branch of Science, but all are decidedly of opinion that a very large sum should be put on the estimates annually for the promotion of Science. Nearly all the witnesses who have been examined on this point are of opinion that Government, under judicious advice, ought to make grants to existing scientific institutions, to university laboratories, and to private individuals, to enable them to carry on research that is likely to lead to valuable scientific results. In addition to this, however, such men as Sir Wm. Thomson, Dr. Frankland, General Strachey, Prof. Owen, Dr. Joule, Dr. De la Rue, Dr. Carpenter, Col. Strange, Mr. Gore, and others, express a most decided conviction that one of the most efficient methods by which Government could

further research in this country is by the establishment of public laboratories for the pursuit of scientific research in connection with the various and ever-multiplying departments of Physics, Chemistry, and Biology, adequate research in connection with which is admittedly quite beyond the means of private individuals. The evidence in favour of institutions of this kind is very strong indeed whether we consider the number and position of the witnesses or the earnestness and decision with which they express their convictions. It is clearly stated that in this country we are very far behind continental states and America in this respect, and that not only is Science a loser from want of assistance from the State, but the general welfare of the country is seriously impeded. The evidence in favour of the establishment of State institutions for the prosecution of scientific research is so voluminous and strong that it is difficult to select any particular part for quotation. As an example of its nature, however, we may quote what Dr. De la Rue says on the subject of chemical laboratories:—

“I hold it to be so important that chemistry should be extensively cultivated in England, that I would strongly advocate that there should be a State laboratory. That State laboratory should undertake all the chemical work which the Government might require; but at the same time, according to the views which I hold, it ought to be such an establishment as could afford facilities to men who have completed their scientific education, and who might be desirous of continuing original investigations, in which space for working and instruments should be afforded them, and, moreover, if men were not in a position of fortune to continue their researches, in some cases materials and even money might be granted to them on the recommendation of the Council. I may state that of my own knowledge I know that chemical science at present is not progressing in England in a satisfactory manner, that we do not make so many original researches as our continental neighbours, particularly the Germans, do. In Germany very great patronage is given to Science, magnificent laboratories have been built, and the students, who after they are sufficiently advanced are encouraged to make original investigations, contribute at present most largely to scientific chemistry.”

On the question of establishing a Public Physical Laboratory, Col. Strange says:—

“I think it is an absolute necessity on the ground of my second postulate, in which I say that all science should be cultivated, even branches of Science which do not appear to promise immediate advantage. It is one of the most important parts of Science, and cannot be omitted without detriment to all the other parts. . . . Investigations connected with almost the whole of our material economy are required. There is no question connected with sanitary improvement, with water supply, or sewage, or telegraphy, or the enormous number of the requirements of the army and navy, which would not derive advantage more or less from investigations of a physical nature such as would be conducted in a physical laboratory. I think that the whole of our naval and military and social economy is dependent upon investigations such as would be carried on in a physical laboratory.”

A similar tone pervades the evidence of the witnesses who were questioned on the subjects of physiological and biological laboratories, metallurgical laboratories, botanical laboratories, and observatories for astronomical physics. Of those in favour of an observatory of the last-mentioned kind, we might mention the names of Lord

Salisbury, Lord Derby, Sir William Thomson, Prof. Balfour-Stewart, Admiral Richards, Dr. Siemens, Dr. Joule, General Strachey, Dr. Frankland, besides many others.

This may suffice to show the nature of the evidence as regards the duty of the State in the matter of Abstract Science and the method by which this duty should be performed. In minor details, of course, there are differences of opinion, but the weight of evidence is without doubt in favour of the establishment of scientific laboratories by the State, in addition to the encouragement of suitable private individuals and the subsidising of existing institutions. Most seem to be of opinion that at first central laboratories should be established in London only, to be afterwards extended to the provinces, and most of those examined on the subject expressed their decided conviction that the men who gave up their time to the service of Science and the State in these laboratories or elsewhere should be adequately remunerated, indeed be regarded as a superior class of Civil servants. For example, Lord Salisbury, on the question of income, suggests that men who might be appointed to pursue original research by the State ought to have an income of about 1,000*l.* or 1,500*l.*, with a provision for retirement. Other witnesses who spoke in favour of paying public researchers were Lord Derby, Dr. Joule, Sir William Thomson, Sir E. Sabine, Sir Stafford Northcote, Dr. Siemens, Mr. Gore, the late Prof. Rankine, &c.

In order that the State may look after the interests of Science and the scientific interests of the country, it would of course be necessary that some well-organised system should be adopted by which the intentions of the State should be carried out. The great majority of those examined on this point agree that this would be best accomplished by the establishment of a State Council of Science presided over by a Minister of Science, who, however, some are of opinion might also be Minister of Education. But that a special department, or at the least, a sub-department of the State should take the promotion of Abstract Science and Science in its practical bearings on the interests of the country under its wing, seems to be the opinion of the great majority of those whose opinion was asked by the Commission on this question; and they include many of the men most eminent in Abstract as well as Applied Science. This State Council of Science, as we have indicated, is not meant solely to look after the interests of abstract scientific research in the country; its time would be much, if not a great deal more, occupied in bringing to a scientific test and advising Government upon all Government projects in which scientific principles are more or less involved. All are agreed that the cost to the country of such a Council would be nothing compared to the losses which are being continually sustained through the haphazard projection and carrying out of schemes that fail wholly or partially from not being founded on strictly scientific principles. Several of the witnesses, for example, refer to the unfortunate *Captain*, whose blundering construction would have been impossible had the Government had such a Council to consult. As to the size and composition of such a Council, opinions of course differ, though many of the witnesses referred with more or less approval to the long-thought-over and well-matured scheme of Col. Strange.

As to some of the duties which would devolve upon such a Council, we cannot do better than quote from Sir William Thomson's evidence, merely reminding the reader that his statement is typical of the opinions held by most of the other witnesses who spoke to the question:—

"The main object of such a Council would, in my opinion, be to advise the Government on all scientific questions which might come under the attention of the Government, and on all scientific works actually undertaken. With a vast amount of mechanical work which is necessarily undertaken by the Government, and which is continually in hand, questions involving scientific difficulties of a novel character frequently occur: questions requiring accurate knowledge of scientific truth hitherto undeveloped are occurring every day. In both respects Government is at present insufficiently advised, and the result is undoubtedly that mechanical works are sometimes not done as well as they might be done, that great mistakes are sometimes made: and, again, a very serious and perhaps even a more serious evil of the present system, in which there is not sufficient scientific advice for the Government, is the undertaking of works which ought never to be undertaken. . . . One great mistake undoubtedly was the construction of the *Captain*, and I believe that a permanent scientific Council advising the Government would have made it impossible to commit such a mistake. They would, in the very beginning, have relieved the Government from all that pressure of ignorant public opinion which the Government could not possibly, in the present state of things, withstand."

On the question as to whether such a Council would command sufficient public confidence among men of Science, the answer of Mr. P. L. Sclater, F.R.S., may be taken as embodying the opinion of most of the other witnesses. He says:—"I have no misgivings at all upon that subject. I should say that they would meet with general support from men of Science. Most men of Science, I think, see that something of the sort is imperatively required. All lament the piecemeal way in which scientific subjects are dealt with by Government, in consequence of their being subdivided amongst all these different offices, and of there being nobody to appeal to upon a question of Science, and, therefore, I think the proposal to establish such a Council would meet with universal acceptance amongst scientific men."

Into the questions of the size of the Council, whether the members should or should not be appointed for life, &c., we need not enter here; the great point is that the mass of evidence is in favour of establishing such a Council, presided over by a Minister of Science.

The question of the institution of a State Minister of Science has been so often discussed in these pages that we need not go into the voluminous evidence in its behalf which is published by the Commission. While some of the witnesses think that such a Minister's functions ought also to include the department of Education, most of them point out that Britain is the only country in which the interests of Science have no representative in the Government of the country.

It will thus be seen that the Commission has been the means of eliciting from the various eminent men who have come before it a complete and comprehensive scheme for the promotion of Science by the State, and for giving Government the means of obtaining trustworthy counsel in all matters in which scientific principles are in any way in-

volved. In the main features of the scheme nearly all the witnesses who were examined on the subject are at one; many of the details in which they differ are of such a nature as can be settled only by actual trial.

On the many other subjects touched upon in the volume we cannot enter here. Much of the evidence bearing on the Universities tends to prove that the interests of Science are inadequately attended to in these institutions, and that the scientific teachers in some of them have to contend with very great difficulties. With respect to what Universities should do to advance the interests of Science, not to speak of the utilisation of the enormous funds at the disposal of Oxford and Cambridge, such men as Dr. Siemens, Dr. Frankland, Dr. Sanderson, and others are of opinion that for the highest degrees in Science original research should be required; Prof. Balfour-Stewart thinks that Universities ought to afford facility for the prosecution of original research, and Dr. Carpenter that University Fellowships should be given to men employed in original research.

Many of the most eminent witnesses—as Sir B. Brodie, Lord Salisbury, Dr. Frankland, Prof. Williamson, Colonel Strange, Sir William Thomson, &c.—are of opinion that research ought to be endowed quite apart from teaching in the ordinary acceptance of the term.

Most of the witnesses who spoke to the condition of Science in this country contrasted it with the great encouragement given to research in nearly every other European country, and in America. In this relation we cannot help quoting a very striking statement made by Sir William Thomson in respect to France, in answer to the question as to how many institutions for research he would recommend.

“There should be five,” he says. “One at present exists, namely, the Royal Observatory at Greenwich. Another in my opinion is very much wanted, an observatory for astronomical physics; then again a physical laboratory, and a laboratory for chemical research, and a physiological laboratory are necessary. In respect of such institutions, I believe, we might with great advantage obtain information, with a view to following example, in Paris. The strong feeling of the necessity to promote scientific research which was evinced shortly after the recent sad disasters which came upon France illustrates very strongly the national value of such institutions. In the depths of their misfortunes, one of the first strong feelings shown by the most intelligent part of the French nation was the want of rigorous and accurate scientific research. Competitive examinations seemed in France to have swallowed up scientific energy, and there was a strong feeling of the insufficiency of the national institutions for promoting the advancement of Science.”

In conclusion, we cannot do better than quote the forcible and noble language of Sir William Thomson, on the much-discussed question of the “utility” of abstract scientific research. To the question as to some of the objects to be gained by the establishment of a Council of Science, Sir William Thomson replies:—

“The immediate utility of the work is undoubtedly a very important object, and perhaps may be considered to be the first duty of the Government; but yet there is another duty which, although we cannot call it the first duty, is certainly not an inferior duty, and that is, to promote the honour of this country. There can be no doubt but that the inhabitants of this country do get benefit from the feeling of satisfaction that naturally

results from any great scientific discoveries or great advances in Science made by their own countrymen, and especially by the assistance of their own Government. The Royal Observatory at Greenwich is an honour and a glory to this country, and I am quite sure that the money paid for it is very well spent, in the satisfaction that the country feels in the honour of having one of the greatest and best, if not *the* greatest and best, of scientific astronomical observatories in the world. This country undoubtedly has a great permanent possession in the name of Newton and in the name of Faraday. The promotion of scientific research in a regular way cannot make Newtons and Faradays, but it can obtain great scientific results by systematic business-like action, carried out through well-instructed and able men. It seems to me to be a duty of the Government to make the national honour in scientific investigation a subject of its solicitude and an occasion (with due safeguards against abuse) for spending the public money.”

J. S. K.

OUR BOOK SHELF

Proceedings of the London Mathematical Society, vol. iv. Nos. 41-66. (Messrs. Hodgson, Gough Square.)

THE volume before us contains the papers which have been read during the eighth and ninth sessions of the Society. We notice a favourable sign in the much greater number of contributions which have been made in the later session—36 against 15. A large number of the members have been led to take an interest in the meetings, and the papers without losing their former high character are in some cases less “caviare to the general” than in previous volumes. The Society’s first president himself thus wrote, “Not a drop of liquor is seen at our meetings, except a decanter of water; all our ‘heavy’ is a fermentation of symbols, and we do not draw it mild. There is no penny fine for reticence or occult science; and as to a song! not the ghost of a chance.” The Society, however, as we see, has reached its tenth year; and though some of the members drop off for reasons which perhaps may be gathered from our quotation, yet the number of members recorded in this volume is fairly satisfactory: the present number of members of the Mathematical Society is about 117. In Paris the new Society (*la société mathématique de France*) started with almost double this number of members. So far as we have seen, however, the papers of the volume under notice and of previous volumes will not lose by a comparison with the opening numbers of the younger society’s *Bulletin*. Of course no volume would fairly represent English mathematics without having contributions from Prof. Cayley’s fertile pen; here we have no less than ten papers, some of considerable length, principally on curves and surfaces, and constructions for mechanically describing the former.—Dr. Sylvester furnishes only short notes on the properties of numbers.—Prof. H. J. S. Smith contributes an arithmetical demonstration of a theorem in the integral calculus, and two other papers bearing upon linear congruences and determinants.—Prof. W. K. Clifford writes, among other things, upon geometry, on an ellipsoid, and a new form of Biquaternion.—Mr. Samuel Roberts rivals Prof. Cayley in the extent and nature of his communications upon parallel surfaces, and also upon epi- and hypo-trochoids.—Prof. Clerk-Maxwell takes us to another sphere, and treats of the transformation of solids, of the equations of motion, of a system of electrified conductors, and of the focal lines of a refracted pencil.—Lord Rayleigh too takes us into the domain of physical science, in his vibrations in a sphere, the investigation of the disturbance produced by a spherical obstacle on the waves of sound, general theorems relating to vibrations.—A presidential address by Mr. Spottiswoode treats of some recent generalisations of algebra.—Mr. J. W. L. Glaisher writes on