SCIENCE EDUCATION ABROAD.

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EVERY one who reads must know that in our time no subject is more extensively agitated and debated than that of the present lecture. In every civilized country it has become a question of first-rate importance, not only for educators but for business men and statesmen, how the largest amount of success can be attained in the practical application of science to the arts of life. Everywhere, as a means to this end, it is felt to be necessary to provide the widest extent of science education for the mass of the people, and the highest perfection of such education for those who are to take leading places as original investigators or as directors of business undertakings.

From the time when I first had the honour of addressing a Canadian audience, until this day, I have not ceased, in season and out of season, to urge this subject on the attention of the friends of education here, as one of the pressing wants of this country; and within the few past years, feeling that we were falling farther and farther behind other countries, I have made some special efforts to collect additional information as to the state of science education abroad, and to bring this to bear on the public mind here, as opportunity offered.

In my recent visit to Great Britain I had this object specially in view; and found it to be one much before the minds of all educated men, and prominent in conversation and discussion whenever education was referred to. The results of recent industrial exhibitions had painfully impressed the minds of Englishmen with their actual and growing inferiority in important arts and manufacturers to better educated nations. Great efforts were being made to erect new schools of science and to introduce science teaching more effectually into other institutions. The usual expedient in England in all doubtful and urgent matters of national importance, the appointment of a Royal Commission of Inquiry, had been resorted to, while the Commission already engaged in the improvement of the endowed schools had taken high ground on the question of science education. All this was very interesting to me, and I availed myself fully of the many opportunities which offered to visit schools of practical science, and to learn the views of those most concerned in their management; and who, in the true spirit of the brotherhood of Science, were ready to place all means of information at my disposal. What I learned I would now desire in some measure to lay before this audience, with practical deductions bearing on our own condition. While, however, most desirous to convey to your minds the impressions made upon my own, I feel that the subject is too vast to be discussed in an hour, and that I can present but a mere skeleton, unless I confine myself to notices of a few of those institutions which appear to be most instructive with reference to ourselves. I shall therefore, first, shortly define what I understand in this paper by science education, shall then notice a few science schools in England and elsewhere, and shall conclude with some practical applications of the subject.

WHAT IS SCIENCE EDUCATION.

In speaking of science, then, I would restrict your attention to the physical sciences, or those which relate to what we call material things. In this great group of sciences we may recognize three subdivisions, distinguished by the modes in which they are pursued, though shading into each other. (1) Mathematical sciences, or those in which the methods chiefly pursued are those of mathematical reasoning and calculations, as, for instance, astronomy; (2) Experimental sciences, of which chemistry and several departments of natural philosophy may be taken as examples: (3) Observational sciences, such as zoology, botany, and geology. Each of these classes of subjects must be treated according to its own methods; and unless so treated is useless whether as a means of training or for practical application. The learning, for example, of any of the natural sciences, by "getting up" a text book, without actual examples and work, is not of the nature of science education; and much of the undervaluing of science studies as a means of education, on the part of practical teachers, is due to their want of acquaintance with this first truth. Natural history or experimental science taught merely from books, is only an indifferent form of verbal training, and it is no wonder that those who know it only in this way should form a very low estimate of its educational value. To be usefully taught, the pupil must be familiar with the actual objects of study, and must understand experimentally the modes of attaining to results with regard to them. He will then receive a real and valuable kind of education, the benefits of which may be summed up as follows:—(1) The student is taught to observe, compare, and reason for himself, and this in a practical manner, not so easily attainable in other subjects, and tending to give an accuracy of method and quickness of perception and of forming conclusions most valuable in actual life. (2) Much knowledge of a useful and interesting character is acquired; and the student, while learning the uses and properties of common things, may rise to large and enlightened conceptions of the works of God, and the natural laws under which man exists. (3) Men are trained to pursue original investigations, and thus to enlarge the boundaries of science. (4) The means are afforded to utilize natural resources and improve arts and manufactures. With regard to the extent and nature of such science education, it appears to be the result of experience in all the more advanced countries: (1) That there should be special practical schools to train investigators and practical science workers in the departments most important to the welfare of the community. (2) That science study should form some part of a liberal education. (3) That the elements of some of the natural or physical sciences should be taught in all the common schools. (4) That means should be employed to train competent teachers of science. This being what I understand by science education, with reference to its nature, results and methods, let us glance at some of the efforts put forth on its behalf, more especially in the mother country.

THE ROYAL SCHOOL OF MINES.

In London the principal institution for science education, supported directly by the Government, is the Royal School of Mines, Jermyn street, with which is associated the Royal College of Chemistry in Oxford street.

The Royal School of Mines is an outgrowth of the Geological Survey of Great Britain, whose building it shares and whose officers are its chief directors and instructors. This association gives it great advantages, in securing the influence and management of the distinguished head of the Survey, Sir R. I. Murchison, and the services of such eminent practical geologists and naturalists as Ramsay, Huxley, Etheridge and Smyth, as professors, in giving the students access to large and admirable collections in Geology and an extensive scientific library, and in placing the young men under the immediate superintendence of those who have the best opportunities for opening up to them the paths of usefulness and success. The very atmosphere of such an institution savours of practical science, its appliances for work and study are of the most inviting description, and it has several prizes and scholarships for its more deserving students, and gives the title of "associate" to those who pass its final examinations. Notwithstanding these advantages, though it has many occasional or partial students, the number of regular students has been much smaller than could be desired. This may in part be accounted for by its situation in a city not directly interested in mining, and remote from the great manufacturing districts; in part, perhaps, by the want of appreciation of the advantages of science training on the part of the English public. It is certain, however, that the School of Mines, though its instructing officers are second to none in the world, is inferior to the great science schools of America and the continent of Europe in its academical organization, in the completeness of its course, more especially in the direction of literary and mathematical culture, and in the standard of attainment required for entrance. Were it improved in these respects, and enabled to offer a larger number of direct prizes to students, its usefulness might be greatly increased.

Still, with these limitations, the success of the school has been great. It has trained a succession of competent men for geological surveys in the United Kingdom and the colonies. Among others, the present head of the Geological Survey of Canada is one of its graduates. It has also sent forth a number of trained men into mines and manufactures, who have been very successful, not only in introducing new inventions and improvements, but in realizing fortunes for themselves; and it is stated that the demand for these men is much greater than the supply. The course of study in the school of mines extends over three years, and in the senior year the students are allowed options, by virtue of which they may devote themselves specially to chemistry, mining or geology.

The Royal College of Chemistry is a distinct institution, situated in a different part of the town, which is a cause of some inconvenience to the students of the School of Mines, who have to attend its lectures and classes in practical chemistry. It was established originally by a private subscription, but has been adopted by Government. Under the able management of Prof. Frankland, it is a useful institution, and always crowded with pupils. It has, however, accommodation for only 42 practical students, and this by no means of the airy and sumptuous character to be found in the laboratories of the continent of Europe and the United States. Crowded among the shops of a noisy business street, it has no room for extension, and its teachers and students have to submit to many inconveniences which might readily be obviated were it removed to a more suitable locality, and provided with a laboratory fitted up with modern improvements. It must, however, be admitted that the utmost possible use has been made of its too limited accommodation.

THE DEPARTMENT OF SCIENCE AND ART.

The Royal College of Mines, as well as the Royal College of Science, Dublin, and the Edinburgh Museum of Science and Art, are under the direction of the Government Department of Science and Art; but its largest sphere of operations is in the great South Kensington Museum, and the schools connected with it throughout the country. In its last report these schools and classes are stated at 525 in all, with an aggregate of 24,865 pupils. This represents much science teaching; all, however, of an elementary character, and of a small amount relatively to the great population of Britain and Ireland. Much of the teaching is necessarily done by teachers of a very humble grade of scientific attainment; but the most effectual means are taken to ascertain that it is faithfully done, and to give it opportunities for improvement. The principle