

ment of Science of Art." He has for several years been an examiner in Physiology and Zoology, and states:—"I may say that there is now a very considerable amount of sound physiological knowledge displayed by the people who send up their answers to these examinations. I believe that this is a very great step, but it would be a pity that we should remain satisfied with this commencement, for I conceive that there is a great and almost unlimited improvement possible in science teaching, and that, with regard to both of the subjects which I have mentioned as being the great objects of science teaching, that is to say, science on the one hand as knowledge, and on the other hand as educational discipline. The chief conditions of that improvement is the development of the teaching power of the instructors. A great majority of the teachers now teach very much from books, because they do not understand that getting up books is by no means a good method of bringing about a knowledge of science. The consequence is that even the best of the teaching shows more or fewer of the defects of book teaching." The teachers require themselves to be taught the true character of the natural sciences as results of observation, experiment and comparison, rather than of "reading up," as the cant of the class-room phrases it.

The University of London has introduced with great success the degrees of Bachelor and Doctor of Science. Edinburgh has set the example of giving degrees in Agriculture, Engineering and Veterinary Science. Dr. Carpenter adds his testimony to that of Prof. Huxley as to the education of men in schools, and even colleges in which the Natural Sciences are not taught, leaving the mind in a state perfectly helpless in relation to the study of objects and phenomena. This effect of "book knowledge," without applied science, is one well worthy of consideration, and to which too little attention has been given.

Owen's College, Manchester, is one of the newer institutions affiliated to the University of London, and much employed in science teaching. It was founded by John Owens, a merchant of Manchester, who bequeathed to it nearly £100,000. Its students, at first few, have risen to 173. It has also 324 students in evening classes, intended for the benefit of those who must work during the day. Since the foundation of the College, £20,000 has been left to it in benefactions of various kinds, chiefly for founding scholarships and building the laboratory. An endowment is being subscribed to establish a Chair of Engineering in this College, and this by members of the Engineering profession itself, who have given nearly £10,000 to this object already. It is "considered desirable to raise a fund of £200,000 to extend the buildings of the College." Government has promised to give a sum equal to the subscription, and £60,000 has been already raised, with the hope that it will be increased to £100,000. It may be remarked here that the British Government have displayed equal liberality in the case of the University of Glasgow, having given £120,000 to its building fund, the people subscribing with a generosity which does them the utmost credit, £150,000, so that the Government, which had promised to give a sum equal to that which the people might raise, was obliged to hold its hand on reaching the sum above stated.

Professor Jenkin, of the Institute of Civil Engineers, give in his evidence some details as to the *Ecole des Ponts et Chaussées* at Paris. The students have to enter the Polytechnic School after an examination so rigorous that few men could pass it "who could not also be competent to take honors at Cambridge." There are about 900 candidates for 150 received. They remain in the school two years, receiving a severe training in higher mathematics and physics. They then pass by a further examination into the "*Ecole des Ponts et Chaussées*," where they must study not only all the branches of ordinary engineering, but maritime works, architecture, telegraphy, photography, &c. This is merely a specimen of French schools of applied science. The "*Ecole des Mines*" is rather of the most important, and the "*Ecole Centrale*," a school of arts and manufactures, has no fewer than 490 students. In France the graduates of these schools are received into public employments, so that a great competition is at once established.

A large amount of testimony of an important character was obtained from manufacturers and merchants. One of these gentlemen, extensively engaged in the Birmingham hardware trade, testifies very strongly to the good effects of the general diffusion of elementary education in the United States of America, where he had travelled extensively, and the manufacturers of which he proves to be successful competitors with those of Birmingham, even in the markets of India and China. His description of the difference between the American and English artisan, whether or not it be accepted as true in the particular case, is a graphic and accurate picture of the contrast between the educated and the uneducated workman. The subject is the relative facilities for improving and adapting articles of trade to special circumstances and wants. "The Englishman has not got the ductility of mind and the readi-

ness of apprehension for a new thing which is required; he is unwilling to change the methods which he has been used to, and if he does change them, he makes demands of price, by trade rules, which oppose the change of the article. An American understands everything you say to him as well as a man from a college in England would; he helps the employer by his own acuteness and intelligence. On the one hand, I have a man who readily assists me on the road I am going, knowing some things which I do not know myself; and on the other hand, I have a man who stops me on the road, who puts his own ignorance in the way of my knowledge, exhausting me by the efforts I am forced to make to get past him, while he stands before me in the middle of the path."

It is to be observed, also, that this witness, who is the chairman of the Chamber of Commerce, at Birmingham, and evidently a thoughtful and observant man, regards the diffusion of a sound elementary education in America as equivalent to scientific education, inasmuch as it produces habits of observation, reading, and thought, which lead to the acquisition of knowledge of science. It thus supplies the want of direct scientific teaching. He also traces by conclusive evidence the decadence of many branches of manufacture in Birmingham to the competition of more highly educated minds in America and the Continent of Europe. We who stand in presence of the active and educated mind of the United States, should profit by this lesson, else it will be "so much the worse" for Canada.

The mine of educational knowledge in this report could scarcely be exhausted in a dozen such articles as the present, but the lesson which it teaches as to the necessity of scientific education, both for the artisan and the higher classes, may readily be gathered from the extracts which have been given; and in conclusion we may quote the following summary of the recommendations of the report, which are necessarily limited to that department of the subject specially referred to the committee, namely, "the scientific education of the workingman." Parliament, they say, should be urged without delay—(1) "To organize secondary education," that is, technical education of a practical character. (2) "To recognize instruction in natural science as an indispensable element in such education." (3) "To provide for the central, general and local administration of existing funds, with due regard to the wants and capabilities of each branch of industry." (4) "To press forward further measures for primary education." They also recommend the extension of higher schools and colleges of science, and the granting of degrees in science in the older universities.

The appointment of this Committee is itself an evidence that thinking men in England have become stirred with the conviction of the necessity of still further efforts in science education in that country. The present report will strengthen this conviction, and indicate the means of carrying it into practical effect. May we not hope that some effects of this movement will extend to this country, and stir up even the somewhat sluggish public opinion of Canada to appreciate the necessity of that higher scientific culture, without which we shall aim in vain at the attainment of an honourable and prosperous nationality.

We are asked how this may be best done, the answer is furnished by this report. Supposing that we have or can obtain good elementary and higher schools and colleges, we may introduce in the cities evening classes in science for artisans, the teachers paid, in part at least, according to results. Our Commissioners of Schools are competent to do this, especially if they could have some special aid from Government. Science teaching should also be introduced to a greater extent than at present into our high schools and academies,—in the latter it might specially refer to agriculture, and a reward might be held out to the teacher, by giving a fixed sum for each pupil who could pass the required examinations, while other aids could be given to the more able and successful in apparatus and other appliances. Lastly, we might have special schools of science attached to our universities, and fitted to carry such instruction to that high level of scientific attainment and practical application reached in the polytechnic institutions, schools of mines and engineering and scientific colleges of more advanced countries. All this would cost some money, but if Canadian mind is to be cultivated as one of the great resources of the country, the money must be found and the more the better. Our Universities and other institutions already can supply many of the men required, and already possess large means in collections and apparatus waiting to be utilized, and by means of which the cost of scientific education might be much reduced. All that is needed is an energetic movement on the part of the government and people.

D., in *Montreal Gazette*.

3. TECHNICAL EDUCATION.

The following remarks by the *Pall Mall Gazette* are worth atten-