

Special Papers.

OUR HIGH SCHOOL TEXT-BOOKS IN SCIENCE.*

WHEN it was first intimated to me that it was proposed to form an Association of the teachers of Science of the Province, I did not anticipate that I should be entrusted with the task of opening the discussion on so important a subject as that of our High School Text-Books in Science.

The difficulties attendant upon the introduction of such a subject are not few. In the first place there must necessarily be a great diversity of opinion as to what constitutes a good text book; for what may seem such to one teacher—because he has achieved success with its use—may be considered an inferior work by another equally good teacher for the opposite reason. All do not make the same use of text books, although the same end may be attained.

In the second place I feel the greatest diffidence in criticizing books which are the results of the labors of some of our ablest and most enthusiastic educators in these subjects. However, since the task has been assigned to me I shall do the best I can in a way that, I earnestly hope, will not be offensive to any of the gentlemen referred to.

I propose then, to state in the first place what I think a text-book should be; and then to see in how far our present text-books agree with this definition. For convenience in discussion the subjects of the books under review may be arranged in two classes, those which are ordinarily known as the experimental sciences, Physics and Chemistry, and those which are not so truly experimental, Botany and Zoology. Let us consider first the text books in the experimental sciences.

A text-book in each of these subjects should contain no information that a student could be reasonably expected to obtain by experiment. His text-book then must necessarily contain a great number of experiments and the value of the text-book will almost wholly depend on the care that has been exercised in selecting and arranging these. The amount of theory to be introduced into such a work is also a question beset with many difficulties, but if theory is to be introduced at all it must only come before experiments whose complete understanding is impossible without it and after all possible experiments illustrative of it have been performed.

In addition to this, each point should be illustrated by a number of experiments, as it is unreasonable to expect any student to make correct deductions from observing the results of a single experiment. Of course it is assumed that the information sought to be imparted by experiment is in accordance with latest established facts of the Sciences.

With the application of these principles to the Science Text-Books of our High schools my real difficulties begin. I am like a traveler on a narrow, elevated pathway—a step to either side may land me, there is no saying where. However, I shall proceed, dealing with the experimental sciences in the order in which I think it best they should be introduced into our schools.

This brings me first to speak of Physics and the text-books on that subject. That our present High School Physics fairly well agrees with what I have said with regard to Science Text-Books in general, all will, I think, admit. Still, the book would be improved if more prominence were given to the experimental part of the work while many of the sections devoted to explanations might be omitted and their place supplied with experiments illustrative of the points under explanation. It might also be pointed out that the value of the book for school purposes would be materially increased if more experiments were given to illustrate many of the points dealt with, and thus would be preserved to the student one of the most desirable results of the study of Physics, namely, the cultivation of the reasoning faculties.

Another point to which I might refer and which I am forced to consider a fault, but one with which the author is scarcely chargeable, is that too much

is crowded into a work which must be got over in so short a time. It seems to me that if our Third-Class candidates were given a more thorough grounding in the properties of matter, and the several departments—heat, light, sound and electricity—left for more advanced work, say University or First-Class work, more would be accomplished. Believing as I do, that our High School entrants should be taught Physics, a more elementary text-book is, to my mind, an absolute necessity. I have as yet said nothing with regard to suitability of our present text-book for Second-Class work. The difference between the work of the Second and Third-Class forms is so great that it is almost impossible that the same text should be made to cover the work of both forms. The attempt to engraft Second-Class work into our present text can scarcely be considered successful. At present we are practically without a single work that comprises all that is necessary for a thorough preparation of the work in Second-Class Physics. This defect is not attributable to authors of the text-books that may be used, nor to the author of the High School Physics.

With these remarks I leave the text-book on Physics and proceed to a consideration of that prescribed in the sister science—Chemistry. While I humbly beg to differ from the author of the High School Chemistry in the arrangement of the matter of the text in some cases, yet, on the whole, I have found it a very serviceable book in the laboratory and class-room. I may be permitted to point out some respects in which I do not agree with the arrangement of the work. Important laws, such as Boyle's and similar laws, are introduced without any reference to the experiments on which they are based, and which are a necessity, as all candidates have not had the advantage of a course in Physics. The place of introducing symbols, formulæ and equations is not that which I should deem most advantageous.

Another objection—and a serious one—to the arrangement is that the elements are not dealt with in accordance with the Periodic Law, a law which must in future shape all our teaching of Chemistry. Prof. Remsen in his latest work on the subject, I think, a most excellent arrangement, even if not quite in accordance with this important law. He treats oxygen, hydrogen, nitrogen and chlorine in such a way as to show how each element should be treated by itself, and having done this he takes up the elements in groups as arranged under the Periodic Law, with this mistake, however, that he has introduced a formal discussion of the law before he has shewn experimentally that the elements are so related.

The arrangement I have indicated is, to some extent, followed in our High School Chemistry, but that we have a satisfactory treatment of the subject based upon this law of the elements I can scarcely admit. It may be said, however, in excuse for this that at the time the High School Chemistry was published this law had not gained its present prominence.

With a good deal of reluctance I have to point out that some things now recognized as belonging to elementary Chemistry have been omitted. This oversight—and I do not think it is anything more—on the part of the author will no doubt be remedied in future editions of the work.

I have by no means exhausted the subject of Our Text-Books in the experimental sciences, but I have spent as much time on this part of my subject as I deem prudent.

There yet remain to be discussed the text-books on Botany and Zoology. The text-books in these subjects should be so framed as to give the greatest facilities for the cultivation of the powers of observation and generalization. In order that this may be done most effectively a text-book should point out the most typical specimens and indicate the points to which the observation should be especially directed. There are two dangers to be avoided in the preparation of text-books in these subjects. There is first the danger of putting so much into a text-book that it is possible for a candidate to prepare the work for examination from the text-book without that reference to the specimens which is necessary to an intelligent study of the subject. On the other hand the directions for study may be so meagre as to be of very little value to the ordinary student, thus entailing upon the teacher a great amount of arduous labor in order that his class

may comprehend what is to be done. Assuming then that proper specimens have been selected, a text-book should indicate the observations to be made and outline a method of generalization from such observations.

Having indicated what, in my opinion, a text-book should contain, let us see wherein our present text-books agree with or differ from the criterion. First, the High School Botany. In the selection of specimens for treatment in the text I think good judgment has been displayed. All are forced to admit that the specimens selected, generally speaking, are typical specimens and more than that, the arrangement is such as to give the student an easy introduction to the subject. I may be permitted, however, to state that the manner of treatment of the specimens might, perhaps, be changed without at all detracting from the value of this excellent work. In my estimation it is possible to fairly prepare for examination with it without treating the actual specimens as they should be treated. This objection might easily be removed by giving an outline of the observations to be made rather than the full descriptions now given. In other words, the plants are too fully described and thus the cultivation of the observation in the student is not made so much a matter of necessity as it should be. The generalizations in some cases are made in the text when it would perhaps have been better had the methods of generalization been pointed out.

The remarks I have made are specially applicable to that part of the work which treats of the morphology of plants. I might add the further suggestion with regard to sections devoted to physiology and histology that a simple explanation of the methods of research in these departments would be of advantage to the student.

Of that part of the work which treats of classification I have very little to say. After using it for a number of years I find it eminently satisfactory. No Flora that I have had an opportunity of using is so simply and excellently arranged. Although I deem it my duty to offer a few suggestions with regard to the first part of the work, I may say that after all it would perhaps be as safe to leave well enough alone, for I am satisfied that with this book at hand a teacher should succeed in doing good work, and if he does not it would perhaps be as well for him to enquire whether or not the blame rests with the text-book.

I now come to the High School Zoology, the last of the High School Text-Books in Science to which I shall have occasion to refer. The work has been so recently issued and I have had an opportunity of using it for so short a time that it is with a good deal of reluctance I attempt a criticism of it, more especially seeing that it is the product of the pen of so gifted a gentleman and so eminent an educationist as Prof. Wright. It is not within my province in this paper to say anything with regard to the book as a work on Zoology, but only to speak of its suitability as a text-book on the subject of which it treats.

I have said that a text-book on such a subject should deal with typical specimens and I might have added specimens easily accessible to the majority of those who have to use them. That this has been done in the High School Zoology I think can scarcely be claimed. In its specimens have been selected rather with the view of showing relations between different classes than of giving a general knowledge of the class of animals under consideration. The selection of the Menobranch as an Amphibian is an example of what I refer to, a very good specimen, perhaps, but intended to show rather the relation of the Amphibians to the fishes than to give a good idea of its class; and besides it is not readily accessible to all.

Having now pointed out what, in my opinion, are objections to the specimens selected I shall pass on to say a few words as to the manner in which the selected specimens are treated.

The manner of treatment is not that which, in my opinion, is best designed to attain the objects aimed at. More benefit would have been derived by the student had typical specimens been selected, and had he been directed what to observe, the text-book furnishing him with only such a description of the parts as is necessary to enable him to recognize the several parts when he has found them. This style of text-book would throw the student more on his own resources in the matter of observation and description. If the subject of Zoology is to be

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