BIOLOGY IN SECONDARY SCHOOLS.

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Looking at the problems of high-school biology from the standpoint of the great majority of pupils, not from that of the selected few whose interests or plans may sometimes demand special arrangement of courses, my answer to the Departmental Editor's question, "Should the high-school biology be one based on the conception of biology as a single science, using plant or animal materials as occasion demands for developing principles, or should it be separate sub-courses or entirely distinct courses in botany, zoölogy, or human physiology?" is "yes" for the first part of the question and an emphatic "no" for the second part. And the following considerations point to such a conclusion:

The practical problems of the high-school curriculum, viewed from the standpoint of school administration, demand concentration of the biological work into one course *adapted for the great majority* of pupils. Here are the facts in support of this: (a) It is generally admitted that four science courses, one for each year, offer the maximum amount of science desirable for the average secondary-school pupils. (b) Chemistry, physics, botany, zoölogy, human physiology, earth science—a total of six—are the sciences which must be taken into consideration. (c) There are two possible solutions, namely election or concentration. (d) Election means that pupils will fail to get a broad outlook on the field of natural science, and *possibly of all biology*. (e) Concentration of the biological work into one course would leave biology, physics, chemistry, earth science—one for each year of the high school. This looks reasonable from the standpoint of school administration, but is a year in biology satisfactory from the viewpoint of the biologist?

From many quarters we hear the objection that botany and zoölogy have developed into quite separate sciences; and this statement is true in most colleges where research for the few rather than liberal biological training for the many prevails. However, it is now high time that secondary-school teachers of biology begin to distinguish between technical zoölogy and botany viewed as courses leading directly to research and liberal biological courses designated to teach the great ideas or principles of the

life sciences with reference to the needs of the average well-educated citizen. Viewed from this standpoint botany and zoology are not properly two sciences. And this is the standpoint which should be taken in secondary schools where the great majority of pupils are completing their formal education rather than preparing for college. More than anything else high-school teachers of biology need to study more seriously the problems of teaching the science with reference to the ideals of liberal secondary education considered as an end in itself rather than as college preparation. Viewed in this way the teaching of biology in the secondary school becomes the selection and presentation *not so much of the facts as of the great ideas or principles* which may be drawn from organized study of a series of plant and animal forms, and the unified course in biology becomes a logical necessity.

But from the four winds comes the protest that botany and zoölogy are so vastly rich in materials that even with a year for each they can not be "finished." I must confess that I have not been able to get into sympathy with this protest. Why should we want to "finish" botany or zoölogy in one year or even in five, so far as secondary education is concerned? We do not "finish" other subjects in the high school. On the contrary we simply select materials for well-rounded year courses. Certainly we cannot complete a wide survey of either of the biological sciences in a single year, but there are great possibilities of selection when our outlook on high-school science becomes that of liberal education as distinguished from technical education. Take any current high-school book on zoölogy or botany and go through the pages critically questioning each paragraph from the point of view of education for general culture and information, and one is amazed at the amount of matter for which little justification is apparent. Eliminating such material of questionable value, it seems perfectly feasible to combine the essentials, the great ideas, of the two phases of the science of life into a single course. Such a course with its broader outlook would be more valuable to the average educated citizen than would be either botany or zoölogy studied without reference to its sister science. Even laying entirely aside the practical problems of school administration, which are certainly tending to limit biology study to a single year for the average pupils, I believe that ultimately our high schools will adopt a year course in

biology because such a course will best include the important values of biology in secondary education.

The above discussion has included only the information side of the values of high-school biological study. Limitations of space forbid appropriate discussion of the scientific discipline derivable from the study; but I fail to see any valid argument against the year in biology as far as discipline is concerned. On the contrary we may expect to get more valuable scientific discipline from the study of the more important subject-matter which would be concentrated into a year of biology. The possible objections all center around the idea that science study must be carried far into useless detail in order to give the best scientific discipline. This may be true from the research standpoint; but as applied to the everyday life of the average cultured citizen the results of such study of details have been far from satisfying. We seem to be moving rapidly towards that science study which is so correlated with information worth having that the discipline obtained will meet with greater application in practical life.

Summary: The practical problems of the school curriculum seem to demand a course in biology for the majority of pupils, and there is nothing in the content of the science and in approved methods of teaching which opposes this. Considering the recognized values, a course in biology will tend to emphasize the great ideas or principles worth knowing, and there is no inherent reason why scientific discipline should not be as well developed as in any other high-school course in science.

THE PRACTICAL, PEDAGOGICAL AND SCIENTIFIC BASES FOR THE STUDY OF BIOLOGY.

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The "practical" in education has until recently meant, and to most still does mean, that which gives the individual an advantage in his competition with others. As education becomes both public and universal the "practical" must come to mean that which gives the community the advantage in its struggle against its environment, animate and inanimate. The welfare of a civilized community depends, and will with the years more and more depend, upon, *inter alia*, the degree to which its citi-