BIOLOGY A SINGLE SCIENCE.

BY EDGAR N. TRANSEAU.

State Normal School, Charleston, Ill.

A year being assumed as the time limit for biological science in the high school, familiarity with the present methods of presenting botany and zoölogy leads one to hope that there is something better in store for the pupil of the future than the present basis for presenting biological ideas.

Assuredly biological topics can be presented to classes using either plants or animals as a basis. But if we study the plans of most of the text-books now in use in either botany or zoölogy, we must be struck by the dearth of biological principles emphasized.

Is not biology very much in the position of the physical geography and geology of a generation ago? There were so many facts to be presented about topographic *forms*, climates, etc., that physical geography was organized purely on a pigeon-hole system, and the one principle in geology worthy of emphasis was the succession of rock formations. The revolution in these subjects came about by the readjustment of the facts on a dynamic basis. Processes are now made the basis of the subdivisions of the subjects. The same facts are presented, but who does not appreciate the marked advantage of the present system over that of the past? In the older presentation the "wealth of facts" determined the method. In the newer, the processes and basic principles of earth science have determined the method and controlled the facts.

Look at the "best sellers" among biological text-books. The one principle that forms the basis for all is the great principle of development of the more complex from the simpler organisms treated more or less adequately from the standpoint of structure alone. To be sure there are *Anhänge* that treat briefly topics in anatomy, physiology, ecology and economics. Is this not exactly comparable with the succession of rock formations of the older geology, with its *Anhänge* of earthquakes, volcanoes, and primitive man—except that "practical" topics in mining and metallurgy were never urged as a necessary part?

If we have in biology no other great principles about which to organize our facts than that of morphological evolution we ought to be satisfied with the "type series," with such side topics as grafting, pruning, mapping of plant societies, seed testing, corn

products, food inspection, dairying, and cattle raising to enable the student to see "the broad areas of contact with his own life." "Wealth of facts" is the real *bête noir* of those who think that everything that is or was a plant or animal must be assimilated into biology.

There are those who assert that our great pedagogical advantage in biology is our ability to "go from the particular to the general" and that all this would be lost were the subject to be organized about the processes and principles. These may find an answer by examining into the history of physiography. The older physical geography went from "the particular to the general." Would anyone venture to assert that this opportunity for inductive thinking has been lost through its reorganization on a dynamic basis? Is there not more chance for inductive training in the laboratory study of the development of stream valleys than in the contemplation of all the *kinds* of undissected and dissected land areas? Is there not more value "practical, pedagogical, and scientific" in the study of volcanoes from the standpoint of *process* than from the standpoint of "*types*"? I have dwelt on these examples from a neighboring science because this subject has been released from the thralldom of "wealth of facts" within our own times.

Biology will surely come as a scientific subject worthy of a place beside physiography, physics, and chemistry, but not until it is organized on a genetic and dynamic basis. This will necessitate a very different point of view from that of a recent text in which forestry, agricultural and horticultural topics, associated with a harmless chapter on cryptogams, are followed by descriptive matter similar in plan to that of a zoölogical-garden handbook, and some human physiology, with appropriate remarks on corsets, suspenders, and cuts of beef. If this is to be the substitute for our present botany and zoölogy, let us resist every effort for a change. It is a question in my mind whether our attitude should be very different toward the biology that will be constructed by "the selection and presentation not so much of the facts as of the great ideas and principles which may be drawn from organized study of a series of plant and animal *forms*." Is our material of such a nature that we must forever work from the form back to the process? Are there no approaches to the subject except *via* the types?

There is a growing feeling in certain quarters that biology has within its legitimate domain a number of processes and principles

about which plant and animal facts may be grouped in a genetic manner; that variation, heredity, ontogeny, phylogeny, and environmental relations are all susceptible of dynamic treatment; and that on this basis there will result a new biology. Such an advance in point of view cannot of course be brought about in a year, but fortunate will be those who can contribute toward its development.

THE RELATION OF THE SCIENCES IN THE HIGH SCHOOL.

BY H. R. LINVILLE,

Jamaica High School, New York.

A history of the origin of secondary schools would be interesting in showing the process of the accumulation of subjects from the lower years of the college course. One can truly say that the high schools have been produced by the continued insistence of the college on the preparation of students in an increasing number of subjects which were college subjects.

The colleges have "passed on" work that they have chosen not to do, until the high school course increasing from one to four years is now so full that sharp competition has developed between the subjects. There was a time in the history of high schools when mathematics, ancient languages and general history just about took up the energy of the pupils, but when the English and other modern languages, ancient, mediaeval and American history and the sciences, came to claim a portion of the pupils' time, competition was inevitable.

Some of the competition, especially that which threatens between the sciences in the high school course of study, is liable to prove extremely wasteful. There are four (or five) sciences which in relation to the competition for being credited by colleges are striving for a place in the third or fourth year of the course. It is probable that nowhere in the country is there a high school curriculum established that has a science course arranged with reference to the logical relation of the sciences. Usually physics and chemistry have the third and fourth years, and biology and physiography take the first and second years or struggle precariously with the better established sciences for a place in the later years.

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