

It was my purpose to consider in this paper the various collections of the state, private as well as those owned by the various colleges, but the necessary data are not yet in my possession. I trust however at the spring meeting of the Academy to present a tabulated statement covering these points.

This paper, submitted to the Academy at the request of the directors of the state biological survey, is merely an expression of my own personal views, the exact form which this work may take lying wholly in their hands.

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**THE RELATIONS OF THE HIGH SCHOOLS OF INDIANA TO THE  
PROPOSED BIOLOGICAL SURVEY.**

By W. S. BLATCHLEY.

In my opinion the high schools of the state could, in the presence of the proper conditions, be made a most important factor in the prosecution of the proposed survey, and could themselves derive much benefit from it. But, in probably the majority of cases, the conditions are lacking, and before they can be brought about I am afraid the survey will have long since been completed.

It is to the teacher of biology, if to any one in the faculty of the high school, to whom the survey must look for aid. He, or she, alone of the faculty, is supposed to be interested in birds, bugs and flowers to such an extent that they can readily instill in the minds of their pupils that desire to know more of the secrets of nature and of the life history of her varied objects which will cause those pupils to be on somewhat intimate terms with their local fauna and flora, and so be able to note to some degree the more rare and interesting forms of animal and plant life about them, to be able to record the abundance of these forms, their local distribution and the causes thereof, in short all facts which may afterwards be of aid to the directors of this survey and their assistants.

Only teachers who are themselves enthused with the subject can beget the necessary enthusiasm in their pupils, and it is to such teachers as leaders, therefore, to whom the survey must look for aid.

Let us consider then the high school biology teachers of the state as a class, and see whether much should be expected of them by the survey.

We may classify them roughly into three great groups, which, for want of better terms, I shall designate as "fossils," "special microscopists," and "all around biologists." In the brief time at my command I have not been able to gather the statistics concerning these three groups, but Prof. B. W. Evermann, in 1891, wrote to the different high schools of the state for information on this subject and the answers he received disclosed the fact that to the class I designate as "fossils" belongs as yet a very large number, rather let us say a large majority of the high school biology teachers of the state; but, and let us be devoutly thankful, their number is steadily decreasing.

They teach Steele's Zoology by rote. They never see or use a specimen unless it be a horned toad from Texas or a dried sea urchin from Buzard's Bay. They have no zoological works of reference except the pictures in the back of Webster's unabridged dictionary. They spend days in descanting with their classes upon such important biological facts as the "comparative length of the tail in the different species of monkeys;" or, as in a case gone down into history from one of the leading high schools of the state, "on which foot of the Ornithorhyncus does the webbing extend past the toes?" That I am not using hyperbole in speaking of their teaching, let me read you verbatim from their standard author, Steele, the sole fact which he gives concerning the leading family of one of the seven great orders of insects. Here it is:

ACRIDIDÆ.

"The grasshoppers or locusts of the western states belong to this family. They come in such multitudes as to give the sunlight the yellow tinge of dense smoke and to eat a large field of grain in an hour."

And yet, as proven conclusively by Prof. Evermann, the great majority of the high schools of the state, where zoology is taught, use Steele's book alone and teach such bosh by rote. What a travesty upon nature teaching! What a blot upon our boasted advanced scientific methods!

As, yielding to the demands of the times, the "fossil" steps aside, he often makes way for the "special microscopist." The latter is a product of the one sided development theory at present so conspicuous in some of our higher institutions of learning. He is an evolved histological and embryological specialist with a B. S. after his name, and a summer or two's experience at some seaside laboratory to give him added prestige. He is an expert in the use of the microscope and microtome. He knows every detail concerning the embryology of the sea-squid and the develop-

ment of the amphioxus, but he don't know a jumping mouse from a long-tailed shrew, an oriole from a cat bird, nor a Hessian fly from a chinch bug. The only field of nature which he has ever explored, or which he deems worthy of exploration, is the field beneath the lenses of his microscope.

When he assumes the biological chair he does so for two reasons; first, to replenish his exchequer; second, to use his position as a stepping stone to a higher one, where his methods are in vogue.

He finds on entering the high school no equipments for teaching zoology, no collection except a worm-eaten, dried sea urchin and a half rotten, alcoholic horned toad, no library except a worn copy of Steele's zoology. He appeals to the school board for aid. Their belief in the potency of his sheep skin and other credentials cause them to allow him \$300 for supplies. Two-thirds of this he expends for compound microscopes, a microtome and reagents; one-sixth of it he sends to a marine supply house for sea urchins, star fish and amphioxus, and with the remainder he purchases a few standard reference works on embryology and morphology; and then settles down to teach his pupils of fourteen and fifteen years of age in the high school, the same facts according to the same methods which he learned in the great universities where he received his special training.

His pupils bring in for a time birds, reptiles and insects from their native heath, but their instructor can tell the youthful collectors nothing of the habits, life history, or classification of their specimens. Their natural desire for collecting and observation, which, with a little encouragement, would soon have resulted in much good both for themselves and for the high school collection, is soon chilled.

They cease to notice the animals and plants about them, and in a month or two settle down under the teacher's guidance and study, for a year, sections one-three thousandth of an inch thick of some half dozen marine forms, and perhaps, if they know where to find them, of the eggs or tadpoles of a frog or salamander.

At the end of the year they can talk smatteringly of ectoderms, blastospheres, actinial filaments and calyco blasts. They can make fair diagrams of the sections they have studied, but they know little of morphology, less of adaptation and correlation of organs, and absolutely nothing of the classification of animals.

They graduate from the high school and go out into the world. One

out of ten goes to a normal school, college or university. One out of a hundred of these makes zoology a specialty and perhaps follows in the footsteps of his former preceptor. The other ninety-nine become artisans, merchants, professional men or farmers; or, if of the gentler sex, the wives of the above. They go through life meeting daily nature's objects on every hand, yet seeing them not; surrounded by problems interesting and instructive, yet knowing nothing of the problems themselves or of the method of their solution.

They see no order, no relations among the animals and plants around them. Knowing nothing of classification, they are unable to find the name of any plant or animal, which, from some conspicuous external character, attracts their attention. If they should happen upon Kirtland's warbler they would never know but what it was the common "yellow-rump."

Taking all these facts into consideration it is obvious that the proposed survey can expect little or nothing from those high schools where "fossils" or "special microscopists" are at the head of the work in biology. In such schools the "proper conditions" are lacking.

The "all around biologist," if I may term him such, at times succeeds the "fossil." With the money received from the school board, usually a much smaller sum than that secured by the "special microscopist," he purchases one or two compound microscopes, a number of sets of dissecting tools, ten or fifteen gallons of alcohol, some fruit jars, etc., and expends the remainder for general reference works on biology, especially those treating of the morphology, physiology and systematic position of the more common forms of life. These works of reference are in an ascending series, beginning with the more simple, as Huxley and Martin's *Biology*, Huxley's "Crayfish," Hyatt's "Insecta," etc., and advancing to the more complex.

The instructor begins his teaching at the very bottom of the work, with a few simple talks, illustrated by common specimens picked up in the neighborhood, in which he develops the distinctions between organic and inorganic objects, and between plants and animals. A week or two is then spent upon the elements of histology, explaining, by the use of typical sections, the parts of a cell, cell multiplication and the structure of the primary animal tissues. The pupil is then put to work for himself, with Colton's or some similar zoology in hand, upon a grasshopper as a type of arthropoda and insects. Three weeks are spent upon this, and a week each upon typical examples of the other six orders of insects.

After a careful examination of the structure of each type, including accurate drawings of the principal organs of each, and the reasoning, led by skillful questions put by the teacher, from structure to function, the teacher himself gives for one to two days a talk upon the systematic position of the common representatives of the order, illustrating the remarks by fifteen or twenty examples from the fauna of the home county. Questions of adaptation, local distribution and the causes thereof, come up in such talks and are discussed by both pupil and teacher.

After the insects comes a study of a mussel and snail as types of mollusks, and a crayfish as a type of crustaceans. In this way the first half year is spent upon invertebrate forms of life.

After the pupils begin to understand something of the scope of the work a certain group of animals belonging to the county, such as beetles, crickets, snails, batrachians or mammals, is assigned to each one to be worked up during the year outside of school hours. As full a collection as possible of the group assigned is to be made by the pupil. Full notes are kept on local habitat, distribution and the causes thereof, habits, food and so on, these notes to be incorporated into a paper to be read before the class at the end of the year, which paper, together with the collection, shall be graded as part of the year's work.

The teacher goes with the class into the field on a number of occasions in fall and spring, helps each collect in his or her special line, instructs them in the preparation of specimens for a permanent cabinet, cites them to works of reference on their respective groups, etc. All duplicates collected are deposited in the high school collection which thus increases rapidly in size. The "all around biologist" has for his school room motto the following: "He is a good naturalist who knows his own parish thoroughly."

In the work proper the second half of the year is devoted to vertebrates, modifying this work so that after dissecting a type of each class of vertebrates the pupil is required to draw up an accurate description of each of three or four members of the class and from the description determine the systematic position of each by the aid of Jordan's "Manual of Vertebrates."

Following this course of instruction the average pupil, at the end of the year's work in zoology, will have something of a knowledge of the relationship existing between animals and plants and between the different groups of animals themselves.

He will have a knowledge of the gross anatomy of the principal organs of at least a type mollusk, crustacean, insect, fish, reptile, bird and mammal. He will be able to reason from structure to function and to understand at least the principles of adaptation and correlation. He will have gained a certain power of comparison and the power of grasping the leading distinctions between the principal groups of animals. He will be able to go into the field, observe, record and collect the animals of any group in which he may be especially interested. He will be able to take a manual and find for himself the name and systematic position of any animal which he will be likely to meet in his after life.

Morphology, physiology and systematic zoology are then, in my opinion, the three divisions of zoology which should be particularly dwelt upon in high school work; while embryology, advanced histology and microscopic technique should be relegated to the higher institutions of learning.

The "all around biologist" at the head of the work in the high school, constitutes, then, the "proper conditions" to which I referred at the beginning of this paper. Where such conditions exist the biological survey of the state can reasonably expect much aid. There, collections of the local fauna and flora have been made, and can be studied by the specialists on the survey who are interested in them.

There, observers, former pupils or present advanced pupils, can be found, who, when fully informed of the objects of the survey, will be both willing and able to observe, collect and record for the survey. Due credit should be given in all publications of the survey to the high school and to such individual collections. As a further reward, after the work is practically finished, typical collections of duplicate mollusks, insects, fishes, etc., from different parts of the state could be presented to those high schools which have aided materially in the survey. Moreover, copies of all publications of the survey could be furnished them to be added to their reference library. In this way the future biological work of the high school would be more easy and more valuable, and thus both school and survey would derive a mutual benefit from the work in hand.