

**INTRODUCTION TO THE
STUDY OF ZOÖLOGY FOR
USE IN HIGH SCHOOLS
AND ACADEMIES**

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BY

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PREFACE.

Almost every text-book on logic draws the majority of its illustrations of logical processes from the development of the subject matter of the natural sciences. The natural sciences most clearly manifest the universal method of discursive thought; therefore, it is difficult to overestimate their importance as an element in education.

Of all the natural sciences, zoölogy is the one which can be used with the greatest economy of effort to give the mind facility in certain fundamental activities which lie at the foundation of all processes of logical thinking.

As the writer conceives it, the pedagogical content of zoölogy consists in training the pupil to gather knowledge at first hand and to get clear ideas of the objects studied, and in exercising his mind in its power of abstraction, concrete analysis, discrimination, comparison, generalization, and logical definition and in the recognition of logical identity. The results of the study conducted under the influence of such a conception are likely to be very different from what they would be if it were believed that the knowledge of a few animals is the chief end sought. To leave zoölogy out of a course of instruction is to omit the training of the mind in these directions, or to accomplish the same result by a much greater expenditure of energy in another subject than would be necessary in this.

Just as the benefit derived from the study of algebra is not to be looked for in the information conveyed in the answers to the problems that the student so laboriously solves, and the value of the study of Latin comes not from the knowledge of the historical facts that the pupil learns while reading the Latin language, so the value of the study of zoölogy does not depend upon the knowledge of animals that the student acquires, but rather upon the power that the student acquires while gaining that knowledge.

A commendable text-book on zoölogy for high schools must concern itself, then, not so much with the development of the subject as with the development of the human mind. This book is

written from a pedagogical standpoint, and is intended to point out so carefully the content of the subject, and to indicate so clearly a method by which the content may be realized, that no teacher and no pupil who follows the plan here indicated can fail to realize a large part of the value to be derived from the study of elementary zoölogy.

There are at least three stages in the study of zoölogy. First, the one in which the student learns how to study and how to utilize zoölogical material. Knowledge of facts is a very subordinate aim in this stage, and the method of acquiring knowledge is very important. This is the stage of greatest educational value, and is but little transcended in high school work. It is the introductory stage, and justifies the name of Introduction for this book. The second stage is the one in which knowledge of facts is the chief end sought. It is essentially a reading stage. The student must read everything about the subject, or that part of the subject to which he turns his attention. The third stage is one in which the student undertakes original investigation and adds to the world's stock of knowledge.

This analysis shows us that the work of the introductory stage must be largely laboratory work. The writer fails to see how very much good can be obtained from the study of a science that is not pursued in this way. Even the reading of books is not to be recommended, unless they deal with phases of the subject that are not investigated in the laboratory, although in a few instances it has seemed impracticable to avoid giving some information in the text that might be derived from the study of the specimen itself.

In this book it is intended to combine the advantages of Natural History study with laboratory work in such a way that neither shall detract from the value of the other. Under the head of "Additional Facts" are stated life relations and habits of the animals studied which cannot be determined from an examination of their structure. Completeness or fullness in this respect is neither attempted nor desired, but enough is given to stimulate observation. The natural history text is limited to the animal forms studied in the laboratory, or to closely related animals, for it is very doubtful whether the reading about animals foreign to one's locality or experience is at all conducive to observation.

The principal emphasis is laid upon the branch of Arthropods, and the subject of insects is treated first. This is done deliberately and after much thought and trial of other ways. The first

Insects studied represent different families. By a comparison of these insects we generalize and rise to the conception of an Order. The next insects studied represent orders, and by a comparison of their resemblances we proceed to the conception of a Class. The table of differences enables us to frame a logical definition of each order. The next animals studied represent not orders, but classes. By a comparison of all these animals, we generalize and rise to the conception of a Branch. The next animals studied represent branches, and a similar process of the mind leads to the conception of a Kingdom.

It might be possible to use Vertebrates instead of Arthropods for the purpose of forming a conception of the less comprehensive groups, but the inconvenience would be greater. Near the seashore it might be possible to use Mollusks instead of Arthropods as the beginning of the work, but certainly not with such satisfactory assurances of success.

Because of the importance of vertebrate dissection in the study of human physiology, more attention is given to the Vertebrates than is really demanded by the logical development of the plan. The importance of Protozoa in the discussion of philosophic questions leads to a treatment of the subject seemingly inconsistent with the rest of the book, but which it is believed will prove an advantage to the users.

Certain philosophic principles are discussed, when occasions arise demanding their treatment, but nothing is touched upon that does not grow directly out of the laboratory work. Such are the topics of Protective Coloration, Mimicry, Protective Resemblance, Vestigial Organs, von Baer's Principle, Homology of Parts, Metamorphosis, Variation, Development, Economic Effect, Parasitism, Senses and Sense Organs.

Enough work is suggested to occupy the time of a class one period each day for one year of nine months. If a shorter time is given to the study, the teacher may make a selection in one of two ways. He may lay the emphasis upon a smaller number of groups, or upon a smaller number of animals in each group. According to the second plan, a good selection would be to study only the grasshopper, butterfly, beetle, housefly, crawfish, rabbit, clam, earthworm, starfish, hydra, sponge, paramecium. The writer considers it more advantageous to limit the study to Arthropods if the time is very short.

This book is the outcome of ten years' experience in teaching

elementary zoölogy to large classes, and everything indicated in it has stood the test of class-room work many times. It will be found serviceable in a laboratory that is well equipped for work, but is especially designed for those high schools whose equipments are the most meager and whose only hope of obtaining better facilities for teaching lies in making a success of the work with the facilities they already have.

The illustrations are nearly all of microscopic objects, and the only purpose in inserting them is to assist pupils that have not the opportunity to use a compound microscope.

Special attention is called to the forms of the tables of resemblances and differences, and to the demonstration of the homology of the mouth parts of the grasshopper (page 66), to the treatment of von Baer's Principle (page 99), to the three series (page 103), and to the demonstration of rank among animals (page 167).

Grateful acknowledgments for valuable suggestions are rendered to Prof. S. A. Forbes and Dr. Frank Smith of the University of Illinois, to President Howard Ayers of the University of Cincinnati, and to Dr. Frank J. Hall of the Kansas City Medical College.

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