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ENTOMOLOGY AS A PURE SCIENCE*

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My chief concern about this society and its publication (THE FLORIDA BUGGIST) is that it should always reflect Entomology as a true science, as distinguished from Applied Entomology or Economic Entomology. From the nature of our organization, we shall not need to worry about the applied side not being duly represented, for we are practically all economic entomologists, or near-entomologists, or otherwise interested in insects that injure crops. But, if for no other reason than for the sake of those in our organization whose training in entomology has been limited, I believe that we should make every effort to present some papers and articles having a bearing upon the science of entomology in its broader aspects. For instance, Prof. Watson's paper on The Thysanoptera of Florida (THE FLORIDA BUGGIST, Vol. I, No. 4 and Vol. II, No. 1) is such a paper, it being a distinct and permanent contribution to the science.

There was a time, perhaps not a hundred years ago, when science was studied for the sake of knowing, for the information that it yielded about the natural things surrounding us, and the pleasure it afforded to the few. More recently, however, it has become the business of mankind to apply scientific knowledge of all kinds in every-day affairs so that men and institutions have arisen whose primary object it is to make science practical. This condition of affairs has caught the attention of the public and the business man, so that pure science has stood in danger of being neglected. But it is apparent to the thoughtful that in order to

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keep up the supply of new ideas, principles and knowledge for the workers in applied science, the investigations in pure science must be continued. In other words, if new ideas, new principles, new facts were not being brought out continually, the worker in applied science, including economic entomology, would soon be at a standstill.

As an illustration of the importance of isolated and apparently insignificant facts and principles, the development of another science appeals to me, and I believe that this also lends itself better as an illustration.

As an example of the slow accretion of knowledge, sometimes accidental, sometimes fostered studiously by individuals, later by groups of men and students at universities and other seats of learning, and finally by institutions established for the purpose, until the few scattered facts, at first apparently useless and largely curiosities, became developed into a system of related facts and principles, I love to think of the science of electricity and magnetism. From static electricity, generated by rubbing a piece of amber (a fact known to the ancient Greeks 600 B. C.), to the modern telephone, the dynamo and motor, the X-ray, and finally, the wireless, is a far cry. However, any one who knows something of the facts, I am sure, will subscribe to the statement that the modern electric locomotive, for instance, was presaged by the apparently trivial and curious electrical phenomena known to the Greeks, the inventions of the Italians, Galvani and Volta, and later in the coils of wire and magnets of Faraday. I love to think of it, that the germ of the electric motor and dynamo was present in the very simple experiment of the deflection of a magnetic needle by means of an electric current passed thru a wire near it. This simple experiment first demonstrated the relationship between magnetism and electricity, and while apparently useless knowledge then, was a ready-made fact for Faraday and others, so that today we have all kinds of electrical apparatus and machinery serving mankind.

Coming back to our own subject of entomology, the classifications of insects and the studies on structure, particularly of the mouth-parts and their uses, and the manner in which insects breathe, were the foundation on which those who were devising methods for destroying insects could build. While no doubt successful attempts at destroying injurious insects were made by those having no particular knowledge of insects, the process could only be carried on with understanding by those knowing

something of the structure and life history of the insects that they desired to destroy. As an illustration of the futility of blind effort in an attempt to control an insect, I have in mind the spraying operations against the citrus whiteflies in Florida. Power sprayers were bought and an attempt made to spray the groves in a whole county (Orange County, 1906) regardless of the time at which the fly was most susceptible to sprays, with the result that spraying was once more condemned as a failure. The facts were known to the entomologists that had been in the State prior to that time, but whether these facts had not been sufficiently featured in the bulletins or were ignored by the parties undertaking the spraying, I cannot advise. At all events, the whitefly of citrus is now successfully controlled by spraying.

To sum up this part of my paper, it is apparent that no facts, ideas, principles or laws, tho apparently insignificant and useless at the time of discovery, are useless, but will eventually be applied in the life of mankind. The world can never know whether a fact is economically useful and important until it finds out, and for that the world may need to wait a thousand years.

From motives of a pure desire to know, any one could study insects (I mean the insects themselves, not books) from the following points of view; in fact each point of view is a science by itself: Taxonomy; Morphology; Ecology; Psychology—behavior, instincts; Paleontology.

TAXONOMY OF INSECTS

This includes description and classification of insects into orders, sub-orders, families, genera, species, and sometimes varieties. (I should perhaps explain that the term Taxonomy means classification, and is used in the same sense whether applied to the classification of insects, other animals or plants.) This phase of entomology has probably been more extensively studied than the others, and was for a considerable period of the last century the principal subject of insect study. Classification may also have been the very first phase of entomology to engage students of nature. It would only be natural to arrange a collection of insects into groups according to their likenesses and give the groups names. Aristotle was apparently the first to leave a record of this kind. He made a classification of animals, and his classification of insects is only a part of the whole.

MORPHOLOGY

Morphology is the study of form and structure of animals, and logically it should precede classification, as classification is based upon form and structure; but in point of time it largely followed classification, which was then based mostly upon the external characteristics only. Studies of form and structure naturally bring out relationships, and, thanks largely to morphology, we now have classifications of insects, and other animals, that represent more nearly true relationships.

It will be quite apparent that the form and structure of an insect, or other animal, or plant, may be studied from three points of view: Anatomy, Histology, Embryology.

Anatomy.—This consists in the study of the organs, or larger units of an animal. We may speak of the external anatomy and the internal anatomy. External atanomy deals with the shape, structure and relative positions of the external organs: wings, mouth parts, head, legs, eyes, etc., of an insect; internal anatomy with the internal organs.

Histology.—Histology is the structure of living things as manifested by the microscope. From this we learn, for instance, that the organs and parts of insects are made up of microscopic cells, or units, similar to those of other animals and plants.

Embryology and Life History.—A tracing of the development of an animal, be it insect, bird or mammal, prior to its birth or hatching from an egg is called embryology. It may be stated here that some insects are born alive. The complete life history of an animal consists of its several developmental stages, including its embryology. Specifically, in most insects, it includes the following stages or states of development: egg, embryo, larva (grub, caterpillar, maggot, etc.), pupa, and adult. For the study of embryology a compound microscope and other special apparatus is necessary, as well as a knowledge of special methods to preserve the many delicate and microscopic structures found.

ECOLOGY

When a naturalist, whether entomologist or other investigator, studies insects or other organisms inhabiting certain localities in an endeavor to solve their mutual relations to each other and to their environment, we have the science of ecology, meaning, literally, a study of the household.

PSYCHOLOGY: BEHAVIOR, INSTINCTS

This title is quite self explanatory as to its subject matter. The habits and instincts of insects are varied and have been extensively studied. This is especially true for ants, bees and wasps.

The definition of psychology is science of mind, and it may be questioned whether insects have mind, as this term is ordinarily used. The writer, nevertheless, prefers to retain the term, psychology, as it is difficult to believe that there should not be some form of mind involved in all the manifold activities of insects.

PALEONTOLOGY

The study of the remains (fossils) of living things found in the different layers of rock and earth forming the earth's crust is called paleontology. The fossil insects found indicate profound changes in the insect life of this earth during its successive geological periods. Of unusual interest are the insects found embedded in the fossilized accumulations of resin known as amber. Paleontology shows that insects as a whole are, geologically speaking, a recent group. Their soft, or at best chitinized bodies do not readily form fossils and so it happens that, as compared with animals having bony and calcareous parts, their past is poorly preserved.

ECONOMIC ENTOMOLOGY

MEDICAL ENTOMOLOGY

These two sciences were not included in the preceding list because they deal directly with the practical application of entomological knowledge to human affairs. They draw largely for their information upon the phases of entomological science previously noted, altho each has its own problems to solve and investigations to make, and each is just as scientific as the other. The former, however, are regarded as in the realm of pure science, in which the practical application of the results is not necessarily considered, whereas the latter (the subjects of this topic) are in the realm of applied science, where the practical application of results obtained is the primary object.
