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## Systematic Zoology in Colleges

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specialized type and differs in some important particulars (e. g., external scrotum) from most other pinnipeds.†

This excessive virility might lead to the habit of abstaining from food in order to secure and then guard the females. This abstinence in its incipency would not be of very great duration, but the period might be lengthened by almost imperceptible increments throughout hundreds of generations until the surprising results noted above would be reached. The animals live on their own blubber during their long fast, and it is reasonable to suppose that the male progenitors of the sea lions which were the strongest and lustiest and possessed the most blubber, would be able to out stay their rivals, and hence obtain possession of a greater number of females and beget a greater number of offspring than those having less strength and blubber. Thus a process of selection would be instituted whereby animals would eventually be produced possessed of sufficient blubber and endurance to survive the effects of even such phenomenal fasts as are endured by the fur seal of the present day.

In the preceding pages the writer has endeavored to account for the following peculiarities met with among the pinnipeds:

1. The relation between great sexual disparity in size and polygamy.
2. The manner in which polygamy may have originated.
3. The origin and effect of excessive pugnacity.
4. The origin and advantage of great sexual disparity.
5. The origin and advantage of the ability to endure long protracted fasts.

The sexual disparity, excessive pugnacity and ability to endure protracted fasts, are all intimately related to polygamy either as *cause* or *effect*.

Up to a certain point pugnacity and disparity seem to have acted as causes of polygamy. Beyond that point they seem to be effects of polygamy, or at least, are accelerated or intensified by it. The ability to endure long fasts would seem to be purely an effect of polygamy.

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## SYSTEMATIC ZOOLOGY IN COLLEGES.

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BY C. C. NUTTING.

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A few months ago one of the curators of the Smithsonian Institution took occasion, in private conversation, to complain of the fact that our universities and colleges did not turn out men capable of taking hold of a collection of zoological specimens and working it up systematically. He said: "We can find plenty of students from Johns Hopkins, Harvard, the University of Penn-

† For further interesting particulars, see Monograph of North American Pinnipeds, pp. 382-405

sylvania, etc., who can do good work if they are put to investigating the embryology of a single species, or writing a thesis on the histology of certain organs. But we have great difficulty in finding men who are able to take hold of a collection brought in by some dredging expedition, for instance, and identifying and describing the specimens in a satisfactory manner."

Dr. David Starr Jordan, now of Leland Stanford, Jr., University, protested earnestly, in a public address against what he termed the "German craze for morphology," which occupied the attention of biologists almost to the exclusion of much important systematic work which was being neglected.

Theodore Eimer, in his "Organic Evolution," says: "The tendency of the 'Scientific Zoology' of to-day is to neglect the study of entire animals. Anything that is not teezed with the needle, or cut with the microtome or examined with the microscope, is scarcely noticed at the present day, except by those who are exclusively systematists—even in questions connected with the evolution theory. For, strange to say, even the doctrine of evolution is left entirely, in Germany, to the decision of anatomy and embryology; that is, of the microscope, or else is given up to mere speculation, although Darwin himself used neither the former nor the latter, but external form, the life and the distribution of plants and animals, for his theory."

Far be it from me to belittle in the slightest degree the work of the morphologist. Upon the result of his labors must be reared the whole structure of the systematic zoologist. His work is not only important, but it is *vital* to any correct solving of the maze of questions which the systematist attempts to unravel. Upon the faithful and minute researches of the anatomist, the histologist, and above all, the embryologist, the success or failure of the systematist depends. As the foundation is to the building, so is morphology to Systematic Zoology.

But after fully and candidly admitting our great obligation to those who work with the dissecting needle, the microtome and the microscope, is there not still some justification for the complaints of such men as Rathburn, Jordan, Eimer and Cope? Is it not true that our largest and best institutions allow the "German craze for morphology" to monopolize the ground to the detriment of systematic work? Is there not a tendency to convey the impression to the student that there is little to be gained by "studying the entire animal," and that the specimen must be cut up before any observations of value can be made?

For my part, I think the men whom I have quoted have pointed out a real danger, which should be forced upon the attention of biologists, especially those engaged in educational work.

This state of affairs has come about in a perfectly natural way. The invention of the microscope and the perfection of methods in histological and embryological investigations, have literally opened a new world to the scientist, and the usual result of opening a new territory has ensued—a universal rush to occupy every available spot in the land of promise and the abandoning of equally valuable and important fields already under cultivation. But now that the rush is over, and the new territory fairly well occupied by eager and zealous workers, it may not be amiss to ask ourselves whether the old farms "back east" are not worth our attention, especially as we can now undertake the work enormously enriched by the wealth of

facts which come in exhaustless profusion from the workers in the new territory.

One of the main reasons why systematic work has failed to command the attention that it deserves on the part of the college students is a wide-spread misapprehension as to its real nature and scope. A majority of students are wont to regard systematic zoology as particularly to be shunned on account of what they consider its most essential character—an endless succession of fearful names—a veritable nightmare of polysyllabic horrors, the dead languages resurrected for the special discomfort of the unfortunate students. And when we consider the mutilations to which these same dead languages are often subjected before being introduced to the student, the wonder is that any youngster survives the first shock!

I speak feelingly because I speak from a sad experience. Never will I forget the abject despair with which I contemplated the long pages of classification, sub-kingdoms, classes, orders, families, genera and species in the back of Tenny's Manual, all of which I was expected to learn by heart and write on the blackboard under the pathetic delusion that I was learning "Zoology."

Not a single animal, alive or dead, was presented for inspection during a term's work in zoology (save the mark!) and if some of us, impelled by an insatiable desire to learn, went to the woods and secured a few living facts, they were rigorously excluded if not expressly substantiated by the inspired Tenny. And this was in a so-called "university."

The professor of science had a microscope and one slide showing scales on a butterfly's wing, and for any student to have asked for permission to actually use that sacred instrument would have been as appalling as Oliver Twists' request for "more!"

This, although an extreme case, is not by any means an unique one, and many students still regard the endless and, to them, *meaningless*, classification as the sum and substance of systematic zoology.

Huxley hits the nail squarely on the head as usual when he says: "The idea that the ability to repeat any number of so-called "natural classifications," has any thing to do with real knowledge, is injurious alike to students and their examiners."

At the present time, fortunately, but little remains of what Lankester characterizes as "that state of mind which led to the regarding of the classes and orders recognized by authoritative zoologists as sacred institutions, which were beyond the criticism of ordinary men," and he goes on to say: "There was a theological dogmatism about the whole matter. To deny the Linnean, or later, the Cuvierian classes, was very much like denying the Mosaic Cosmogony."

The student should be given to understand that these formidable classifications are but the skeleton which his studies and investigations should clothe with living facts, so that finally the dry bones will be almost forgotten as he contemplates the beauty and the symmetry of the well-rounded, vital structure. He should be taught that classifications, so far from being inspired or sacred or permanent, are but temporary expedients to express the individual opinions of their originators, which opinions change with every review of the group classified.

The main question which I wish to present for your consideration is this: Is the study of systematic zoology especially adapted to the conditions of the

college course? Has it any claim to rank along with structural zoology as a means whereby the best educational results may be attained?

The answer to these questions depends very largely, it seems to me, upon the college or university under consideration. In those institutions where well equipped biological laboratories are at the disposal of students, and the endowment is such as to make successful investigations in morphology possible, the study of comparative anatomy, histology and embryology offers unsurpassed attractions to the student and insures earnest and faithful work of the very highest educational value, unless the instructor is painfully lacking in the ability to use the means at his command.

In institutions possessing both laboratories and museums, both structural and systematic work can be undertaken. In this case, if it is considered best to divide the zoology between two chairs, two courses may be pursued.

1st. The systematic zoology may be regarded as supplementary to the structural, which excludes all students from systematic work who are unable or unwilling to devote two years to zoology.

2d. The structural and systematic work may be offered as two independent and co-ordinate courses, in which case each professor should be free to give so much instruction in the department of the other as may be required for a satisfactory understanding of the work in hand.

But there is a large class of colleges scattered over our State, where well equipped laboratories can not for the present at least, be afforded, and where the duties devolving upon the "Professor of Natural Sciences" are too manifold to admit of his taking the time necessary for good laboratory work even if the equipment were provided. In these colleges, it seems to me, systematic zoology offers some superior advantages if wisely taught.

One cogent argument in its favor is that it need not demand any great amount of equipment to commence with. The compound microscopes and their adjuncts, which usually require the bulk of the outlay in laboratory equipment, can be dispensed with. Dissecting microscopes, or even good coddington lenses with a few inexpensive accessions will suffice for the work. Considerable field work is indispensable on the part of both instructor and students. But field work is the very best way to learn zoology and is withal the most attractive and physically beneficial.

Text books can and should be eschewed *as* text books, and their place taken by some reliable manual, as Jordan's.

The time for going over the whole animal kingdom in a single term has long since passed. It can never result in anything but "going *over* it" in a very literal sense, without going into it at any point. Almost every teacher who can be said, in any true sense, to be prepared to teach zoology has made a more or less special study of some definite group of animals. That means that he knows a great deal more about some particular kinds of animals than of any others. Now, it is manifestly his wisest course to dwell most upon that which he knows the most about.

Let us suppose, for instance, that the "Professor of Natural Science" is an amateur ornithologist. Birds, then, are obviously the animals which he should teach about. He, in all probability, has several of the standard works on ornithology such as Coues' "Key," Ridgway's "Manual," and perhaps Baird, Brewer and Ridgway's "History of N. A. Birds." It is likely, too, that he has a more or less extensive cabinet of bird skins. If not he can put his

class to work collecting. Any boy that is old enough to go to college is old enough to handle a gun, and there are natural collectors in almost any class. It may be a survival from savage life, but a boy who does not like to hunt is a rare and abnormal specimen. The boys will provide specimens, or some resident farmer's lad will gladly scour the woods and secure birds at a few cents each. After the instructor has given a few preliminary lectures on the general character of animals, Vertebrata, Aves, the external parts of birds, he is ready to instruct them on field work, and spend a half Saturday with the class in the woods, each person armed with his field note book and two or three armed with shot guns. Jordan's "Manual" can be used in identification of specimens. But there is a distinct danger in the use of manuals, or rather in a sort of slavish adherence to them. The manual is intended simply as a means of identification usually by purely superficial characters, and its unrestricted use is apt to give undue prominence to these characters in the mind of the student, while other facts of fundamental significance are allowed to pass unnoticed. The manual should be supplemented by some more extensive work of reference such as Baird, Brewer and Ridgway's.

Give a specimen to each student, if there are enough to go around, or let several work together on one specimen. It is by no means enough for the student to simply identify the specimen, for he should learn all he can about the habits, distribution, etc., of the species represented, and report all these facts to the class for general discussion and comment by the instructor. Certain specimens will furnish texts for special lectures on such subjects of general interest as protective coloration, migration, secondary sexual characters, rudimentary organs, adaptive structures, mimicry, nesting habits, etc. Such talks will seldom fail to secure the attention of the class when brought in in reference to some specimen recently secured and studied. The instructor will often make the unexpected discovery that whole animals and live animals are often fully as interesting to bright boys and girls as animals which have been teezed with the needles or cut up with the microtome.

Two lectures a week, upon which full notes are taken and copied in permanent form, two hours devoted to field work, two to preparation of specimens, and two to identification and study, will fill up the time in a manner which will give variety to the work, exercise to the body, induce habits of observation and discrimination, and bring the student into direct contact with Nature. What more can we expect to accomplish in the time usually allotted to zoology in our smaller colleges? The best ornithologists that we have become so by this very method of field work, combined with the consequent identification and study of specimens and recording of observations.

Year after year the cabinet will become more and more complete, and the gaps in the series less and less conspicuous, until the local fauna will be well worked up for publication, when both class and instructor will feel that they have actually contributed something to the sum of human knowledge. The true spirit of the naturalist which has lain dormant in many a boy and girl, will be awakened to life and healthful activity; thanks to the teacher who wisely introduces them to Nature at first hand, without the dreary intervention of the text book and the disheartening task of learning pollysyllabic "classifications which have nothing to do with real knowledge."

Of course, the above is offered simply as a sample of a method of teaching systematic zoology. If the professor is an entomologist, let him make insects the subject of the term's work; if a conchologist, mollusks will yield the best results. If he has never become especially interested in any group of animals he should seriously consider the question as to whether or not he has missed his vocation.

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### OVIPOSITION OF ANOMALON SP.

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BY C. P. GILLETTE.

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While passing an apple tree August 18, on which were a brood of *Datana ministra* larvæ about one-third grown, my attention was attracted by the presence of a large Hymenopterous parasite busily ovipositing in their soft bodies and apparently much to their discomfort. The parasite was a large black *Anomalon sp.* not in my collection, unless, possibly, it is a variety of *A. pallitarse* Cress. It differs from Cresson's description by having its middle and hind pairs of legs entirely black and its face and antennæ entirely yellow.

This parasite was so intent upon her work that she did not leave when I pulled the limb down close to my face so that I could distinctly watch operations. The entire brood of larvæ were apparently alarmed and were striking their heads violently from side to side to frighten away their enemy. The parasite stood upon a leaf in easy reach of a number of her victims, watching their movements and as soon as one became quiet enough she would quickly thrust it with her sharp ovipositor. The manner in which this was done was what especially interested me. I had supposed that these parasites would stand upon or above their victims and thrust down upon them, but such was not her manner. I was reminded of one who fences and with a quick thrust straight in front pierces his combatant. This insect stood upon her two back pairs of legs the front pair not being put to any use. The long abdomen was bent under the thorax and between the legs and the thrusts were made straight in front of the face. As the abdomen was brought forward the short ovipositor pointed straight in front like an index finger.

The larvæ when pierced did not drop to the ground but threw their heads higher in the air and ejected a dark colored liquid. So far as I saw, but one egg was deposited in each larva.