Behavior and Classification: Some Reflections

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Animals and plants can be classified on the basis of their morphology, on the basis of their physiology, or on the basis of their behavior. Morphology offers certain obvious advantages, since anatomical specimens, once collected, can be preserved indefinitely and since, in the case of fossil forms, so vital to classification, we know only the morphology. Physiological differences can sometimes be expressed quantitatively, although the materials on which they are based are usually non-permanent and can be studied only in the living animal. Finally, behavior can merely be observed, and to some extent experimented with. All would agree that of these three main sources of data for the systematist, it is the most intangible and the least quantitative.

It is easy to show that different species, genera and families of birds have distinctive behavior. Among the northern hawks, for example, one genus *Accipiter* feeds on birds which it catches by short bursts of rapid flight. The genus *Buteo* contains species that soar and then pounce upon less active prey. The Osprey (*Pandion*), eats only fish, and so forth. Even within the genus, species distinctions in behavior are the rule rather than the exception. Careful studies always reveal more than might at first be apparent. LORENZ, for example, has described many species traits in the courtship of the ducks of the genus *Anas*. Behavior may vary in subspecies also and this is a part of the process of gradual change leading to new species. Geographical innovations in behavior are especially apt to occur in races that are isolated in unlike types of environments. LACK (1942) has listed a number of British tree-nesting birds that nest on the ground on the treeless islands near Great Britain. CAMPBELL (1948) has described how the Red-winged Blackbird (*Agelaius phoeniceus*), which usually attaches its nest to reeds, utilized other situations on an island where there were no marshes. One nest was even in a hole made by a woodpecker in a tree.

Differences in behavior characterizing groups at whatever taxonomic level, are of value to the systematist only if they are reasonably consistent. Without belabouring the point, it may be said that such differences as those mentioned above as characterizing the various genera of hawks, for example, are consistent. It has, therefore, been customary to refer to these behavior patterns as "innate" or "instinctive". One group of present-day psychologists, of which SCHNEIRLA is perhaps the leader,believes that all behavior should be studied from an ontogenetic point of view and that, when it is, learning is always a part of what may too facilely assumed to be "instinct". For this reason SCHNEIRLA eschews the use of the word "instinctive" altogether. LORENZ and his school, on the other hand, have been associated with claims for the importance of innate patterns in animal behavior.

I do not believe that the systematist needs to be too concerned about this conflict of opinion. A lion can learn to hunt antelope. It can also learn to jump from stool to stool in a circus ring. The important thing is that it learns to hunt antelope without a teacher, whereas it must be taught to do the circus trick. The systematist is interested in the former kind of behavior, that in which, although learning may be involved, there is a genetic basis insuring that under normal life conditions a certain pattern of behavior will develop with reasonable consistency.

It is true that in the behavior of the higher animals some degree of teaching or at any rate mutual stimulation seems sometimes to be involved in learning of the genetically motivated type. Lion cubs play together at mock hunting, just as do the kittens of other species of cats. MEINERTZHAGEN (1954) has described how adult Ospreys seemed to be teaching their fledged young to fish by raising a fish high in the air, dropping it and diving after it. Nevertheless, I think we can take it for granted that both the young lions and the young Ospreys would learn to feed in the way normal to their species, even if reared in isolation. The only difference is that more of the young might succumb to starvation during the critical period between that of parental care and self care.

Mrs. LAWRENCE (1949), for example, showed that a young Merlin (*Falco columbarius*) reared by itself away from others of its species, learned first to make passes in the air at floating objects, such as thistledown, then at larger insects, such as dragonflies and finally learned to catch in flight small birds, after the manner of its species.

WHITE (1953, page 3), writing of captive young of the Belted Kingfisher (*Megaceryle alcyon*), stated: "That the instinct to catch fish is present early in the young was shown by the behavior of these hand-reared birds. For some days before they were able to fly, they would become very interested in minnows swimming in a pan of water. And when a young bird was placed on a perch above the pan, it would make a rather ludicrous attempt to dive for the minnows. By the fourth or fifth day, they were attempting to catch fish by diving from low perches and by the seventh or eighth day they would be catching some small fishes."

DILGER (paper presented at the meeting of the American Ornithologists Union, New York, October 1958) has described the behavior of certain African Love Birds of the genus *Agapornis*. Some species of this group are known to have the curious habit of tucking shreds of nesting material under the feathers of the back and carrying them thus to the nesting place. Hybrids were secured between a species having this habit and one of the same genus in which it was lacking. The hybrid showed curiously ineffectual behavior in which repeated but half-hearted attempts to place nesting material among the back feathers were made, always unsuccessfully. It would seem quite clear in such a case that genetic factors must be involved. Indeed, one might be tempted to suggest that the word "learning" can be overdone just as much as the word "instinct". If the one is to be dropped from scientific work, perhaps the other must follow.

It is scarcely necessary to add that even in groups where behavior seems to be most stereotyped, such as insects, one would postulate, and I am sure could demonstrate, sufficient genetic variability to permit the changes that must have taken place during the evolution of the diverse types of behavior we now find.

If we concede, then, that consistent differences in behavior do exist among systematic categories, it remains to demonstrate that these are of appreciable value in the classification of animals, and in particular birds. It might be argued that behavior merely reflects anatomy and is less amenable to systematic study than are the morphological characters determining the behavior. For example, we do not need to classify the Osprey on the basis of its fish-catching behavior. There are a number of tangible anatomical adaptations connected with this way of life, which can be studied and described in exact terms. And, in this case, there are other anatomical distinctions, perhaps of a more basic nature, indicating that this particular genus is somewhat apart from other hawks. The classification of birds, however, is by no means always characterized by such clear-cut entities. In general they show relatively few anatomical characters. This is a particularly true of the 5000 species that comprise the great order Passeriformes. Furthermore, fossil birds are scarce, and this again is particularly true of the smaller species which make up the order just mentioned. The avian systematist, therefore, is glad to have assistance from whatever quarter possible, and it has become clear that behavior can, indeed, furnish valuable aid to him. Birds show relatively little morphological variation and much of it is associated with feeding adaptations and hence is sometimes of dubious value to those seeking the broader lines of relationship. Patterns of behavior, other than feeding behavior, may sometimes be useful.

The North American Cowbird (*Molothrus ater*), for example, is very finch-like (Fringillidae) in many ways, including the structure and shape of its bill, which of course is concerned with feeding. The courtship behavior and vocalization of the male Cowbird, on the other hand, are so unmistakably similar to those of various Icteridae as to leave little or no doubt in anyone's mind that it is in this family that the genus belongs.

As an example of the discretion with which evidence bearing on systematics must be interpreted, one may mention that the genus *Molothrus* is parasitic and makes no nest, whereas most, though by no means all, of the Icteridae are well-known for their skillfully woven hanging nests.

A similar example is known in the family Ploceidae in which most of the species weave nests, but a few are parasitic.

So subtle and difficult of interpretation are the anatomical criteria separating even major categories of birds that behavior may sometimes be of service. For example, the division of the Class Aves into main groups according to the structure of the palate by THOMAS H. HUXLEY has been brought into question, particularly as regards the so-called giant flightless birds or Ratites. MCDOWELL (1948) and other recent workers have taken the position that these birds may be divided into at least five divisions all probably of independent phylogenetic origin. The groups would be (1) the Ostrich (*Struthio*), (2) the Rhea (*Rhea*), (3) the Emu and Cassowary (*Dromaeus, Casuarius*), (4) the Kiwi and Moas of New Zealand (*Apteryx, Dinornis*), and (5) the Elephant Bird of Madagascar

(*Aepyornis*). The palatal similarities between these birds may, as McDowell has stated to be the case, depend upon parallel adaptations for grazing and browsing, although there is still a difference of opinion on this point. There is, however, one aspect of behavior which most of these birds share and which suggests actual relationship. This is the fact that in the Rhea, the Emu, the Cassowary and the Kiwi, the male takes over the entire duties of incubation and the care of the young. The Ostrich is, to some extent, an exception, but even in this species, the male is said to incubate at night and perhaps to take the major share in incubation. In the tropical American tinamous (Tinamidae), which are believed by some to be related to the Rhea, the male also performs the incubation and cares for the young.

Another instance in which behavior may be of help in straightening out major categories of birds, is with the Swifts (Apodidae) and the Hummingbirds (Trochilidae). These birds have commonly been placed as suborders in the same order, but some have wondered whether the alleged similarities are not largely the result of parallel adaptations for flight. Recent observations, however, especially by Pearson (1953) on the Hummingbird *Oreotrochilus*, which lives on the high plateau of Peru at 12 000 ft. or above, suggest that the two groups may be related. This Hummingbird nests in mine shafts and caves, a Swift-like habit, and like the Swift it uses saliva in gluing its nest to the cave wall.

There has long been discussion as to form and function in evolution and as to whether one precedes the other. In the final analysis, before behavior can take place, there must be the anatomy that makes the behavior possible. Before an animal can run, it must have legs. Comparison of a tortoise and a hare, however, shows how great may be the gamut of adaptations for the same function. Indeed, most evolution may be regarded as a gradual process of adaptive change in which function and form are modified hand in hand as selectively superior mutations and genetic combinations become available. In pre-adaptation, a structure may exist in complex form before it is turned to a new use, but even then later adaptive modifications will certainly be the rule, and perhaps invariable.

Of present concern, however, is the extent to which the opposite takes place. How often is behavior an antecedent to form or to anatomical adaptation. Waddington (1959) in a recent review of the symposium volume "Behavior and Evolution", edited by Simpson and Roe (1958), remarked that none of the contributors discussed this very factor: the role played by behavior as a determinant of evolution. Changes or trends in behavior may doubtless at times anticipate changes in morphology. When this reflects changes in the adaptive milieu, nongenetic modifications may temporarily permit survival until the necessary genetic combinations and mutations place the adaptation on a genetic basis. Evolution, moreover, is opportunistic and different species or groups of species may respond in different ways to what is essentially the same selective situation. This, of course, is the basis for parallel and convergent evolution.

In many cases of the kind just mentioned, study of behavior may help the systematist in unraveling relationships. Among the Swifts, for example, one finds a genus *Chaetura* in which the tips of the tail-feathers have modified, spiny tips. These are used by the birds as a prop as they perch, clinging vertically to the inside of a tree trunk. One finds, however, that in the genus *Apus* some of the species, such as the Common Swift (*Apus apus*) of Europe, perch in an identical manner. Even though their tail is slightly forked and its feathers are not spiny-tipped, they are jammed against the supporting wall and provide support. This similarity in behavior lends plausibility to the conclusion that these swifts are really more closely allied than might be assumed by study of the structure of the tail-feathers alone.

In the pheasant family (Phasianidae) one finds a group of species that has ocellae or eye-spots on some of the feathers. In the Peacock (*Pavo*) the spots are on the modified and greatly lengthened upper tail coverts. In the Argus Pheasant (*Argusianus*) the eye-spots are on the wing-feathers. In the Peacock Pheasant (*Polyplectron*) and in the Ocellated Pheasant (*Rheinardia*) the eye-spots are on the tail-feathers, although these two genera are very different otherwise. In all of these pheasants one finds certain more or less similar types of male display. The ways in which selection, acting upon available mutations, has "interpreted" this display in terms of plumage modification and color varies from species to species as described. One would certainly not object to placing these pheasants in different genera. Yet the basic similarities in display provide another instance in which behavior shows birds to be more closely related than one might at first conclude. It is selection that calls the tune and it is then up to the organism to respond adaptively as best and in whatever manner it can. At the moment we are concerned with instances in which behavior guides selection. Behavior itself may be closely controlled by the environment, as in feeding or nesting activities, or it may have less immediate subservience to the environment, as in courtship displays.

It is the branches of biology that view the animal as a whole that must give biology its meaning and significance. Ecology is one such integrated science and behavior is, or can be, another. So far as its use in systematics is concerned, it is necessary to call attention, as has been done here, to some of the difficulties of interpreting behavior. At the same time we must remember that behavior, studied with sensitivity and vision, can supply the systematist with important clues and data as he attempts to assess a welter of anatomical and physiological characters.

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