

mosome numbers and experimental embryology is covered.

I take advantage of this opportunity to reflect upon the place of phylogenetics in such general zoological literature. Abbott probably knows as much about invertebrate phylogeny as anybody, and he provides good orientation to the views of various people on such matters as gastropod torsion and the alleged polyphyly of arthropods. However, the book as a whole tends to treat phylogenetics as if it were not to be taken seriously. To judge from the kind of pseudoscience generally dished up to undergraduates this is only what one would expect. But things are changing. If we want to understand why organisms have the properties they do, we need, if not a cladistic hierarchy, at least some representation of branching sequences. The chapters on euthyneurous gastropods by Beeman and Williams, and on barnacles by Newman and Abbott do take account of recent advances and do present higher classifications that are reasonably close to genealogical relationships. However, it is obvious that invertebrate zoology has a long way to go before it divests itself of typology and gradism.—*Michael T. Ghiselin, Department of Biology, University of Utah, Salt Lake City, Utah 84112.*

Syst. Zool., 30(2), 1981, pp. 219–221

The Age of Birds.—Alan Feduccia. 1980. Harvard University Press, Cambridge, Massachusetts. viii+ 196 pp. \$20.00.

Reconstructing the history of life has been and continues to be the central goal of systematic biology. The theme of this book is the history of life, more specifically the history of birds, and as such, it is within the mainstream of systematics. The aim of the book, in the author's words, is

“to tell the story of the evolution of birds in a way that will appeal to people of diverse interests. Rather than analyzing every avian fossil and living species of bird, I have included only enough detail to explore important issues in avian evolution and phylogeny. Some of the ideas expressed in this book are new ones that have not yet withstood the test of time, but my aim has been to provide the reader with more than the static dogma of the past century.”

Because the book is clearly written with broad appeal in mind, I suspect it will be fairly influential in conveying to both the specialist and nonspecialist a sense of where we are in our knowledge of avian history, how we got there, and what will be the central problems for the future. Given its generally excellent writing style, its engaging illustrations and lay-out, and the commendable promotional program of its publisher, the book is certain to be widely read and, if the available reviews are any indication, admired.

In as much as this is the most comprehensive

statement about the history of birds to be published in over a half-century, how is the scientific community—ornithologists and systematists—to judge this book? Although ostensibly written for a more general audience, one clear purpose of the book is to provide scientists, professionals and students alike, with a summary of the current status of the field. Accordingly, its contents should be subject to the same critical evaluation we would expect for any scientific text. Moreover, if the lay public is to come to understand what it is that scientists do, how they do it, and what they think they know, then books written for that audience must be candid about the nature of scientific inquiry and must convey an accurate assessment of the content of contemporary scientific thought. So on this basis, too, a book of this genre should be evaluated in terms of its scientific method and content.

There are eight chapters. The first three treat the general topic of avian origins and discuss *Archaeopteryx*, the relationship of birds to reptiles, and the evolution of flight. The remaining five chapters partition avian diversity into five groups, apparently organized in terms of similar adaptive types: toothed birds and divers; shorebirds, ducks, and waders; flightless groups; birds of prey; and land birds. The emphasis in these chapters is on the fossil history of the taxa and present-day diversity. It should be pointed out here that the book is highly biased with respect to its coverage of avian history: only two paragraphs are devoted to the oscines, which constitute over half of the known species of birds and which dominate the diversity of most avifaunas.

Any discussion of the history of birds necessarily must address the issue of phylogenetic analysis, because corroborated phylogenetic theories of relationship are undeniably the core of our knowledge about history. Thus, the success of a book such as this ultimately rests upon the methods used to reconstruct the interrelationships of the taxa and, quite obviously, upon the quality of the hypotheses that result from the application of those methods. What, then, is Feduccia's method of phylogenetic reasoning? Well, there is none to speak of. The method used in this book is set squarely within the tradition of nineteenth century transformationist paleontology: find those ancestors and let the fossils speak for themselves. Some typical comments on method:

“In attempting to construct a genealogical history, or phylogeny, for birds, we must look both to living forms and to the fossil record of ancient birds Most bird fossils are also fragmentary, or consist of single bones, and it is only the rare find of an associated skeleton that allows major advances in an effort to establish evolutionary relationships” (p. 1).

“It is the fossil record that allows us to place organisms and their lineages on the geological time scale . . . and permits us to see changes in diversity and morphology through time” (p. 8).

Now even the most die-hard paleontologist seeking ancestors in every outcrop realizes that somehow or other fossils must be compared, either to other fossils or to extant taxa. So too does Feduccia, and he makes an occasional concessionary remark to the effect that derived characters can be used to define monophyletic groups. Yet, either he does not really accept that notion or does not understand how to proceed with it (or both), because he only rarely adopts it as a method, perpetrates the myth that "beneath their feathers, birds tend to be very much alike" (thereby implying comparison will be fruitless), and repeatedly adopts reasoning that is logically contradictory to the idea that synapomorphic similarity leads to statements of monophyly. As an example of the latter, one can cite the belief, rampant within systematic ornithology, that differences among taxa are evidence of their nonrelationship:

"Thought by some to be most closely related to the giant moas, kiwis are so manifestly different morphologically that this seems highly unlikely" (p. 128).

"The diversity of morphology shown by the ratite pelvis is another feature arguing against the unity of the group" (p. 133).

If such curious reasoning were restricted to systematic ornithology I would immediately apologize for my colleagues, but unfortunately this is a problem within systematics as a whole. One can only marvel at a reasoning that denies the very thing that is supposedly under investigation, namely, descent with modification (=evolution). If it is indeed the case that differences indicate nonrelationship, then perhaps the creationists are right after all, because obviously all taxa are different from one another to some degree: ergo, there can be no pattern of relationships.

This mode of reasoning leads Feduccia (and most systematic ornithologists) to see convergence lurking around every corner: loons, grebes, and *Hesperornis* (pp. 72-75), ratites (pp. 117-135), hawks and owls (p. 137), swifts and hummingbirds (p. 155). In most of these cases (the ratites are the primary exception), many 19th and early 20th century workers perceived similarities among the members of these groups and concluded they were related, and it is my opinion these early workers were correct. The critical point of this discussion is that the question of convergence or relationship of these groups is not one of different perceptions of the raw empirical data but of differences in the reasoning used to interpret those data. In none of these examples does Feduccia present any evidence for alternative phylogenetic hypotheses, which are obviously necessary if an argument is to be made for convergent similarity.

The core of Feduccia's difficulty with the problem of convergence seems to be his conception of character analysis. Thus, he writes that

"When comparing the structural features, or morphology of birds in order to reconstruct phylogenies, we must ascertain whether similar structures are homologous, meaning that they can be traced back to a similar condition in a hypothetical common ancestor; or convergent, and therefore not indicative of evolutionary relationships" (p. 8).

"In comparing structural features it is most useful to be able to determine which characteristics are primitive, that is, are actually present in the hypothetical common ancestor; and which are "derived," that is, have evolved in lineages after branching from the common ancestor" (p. 8).

But, it may be asked, (1) how do we "trace" conditions back to "hypothetical" ancestors, (2) how might we ascertain whether a similarity is convergent before we possess a phylogenetic analysis based on other characters, and (3) why would we assume derived characters evolved, in descendant lineages *after* an origin from a common ancestor rather than having been present in the common ancestor to begin with? Perhaps all this begs the issue, given the fact that no consistent method of character analysis is adopted throughout the discussion. This ambiguity over methods of comparison has resulted in the absence of precisely stated, testable hypotheses of relationship. For example, only one phylogenetic diagram is presented (p. 180), and in this case lines symbolizing relationships are either dotted or do not connect with one another (in other words, it is not appreciated that phylogenetic hypotheses are of little value unless they are stated boldly). To be sure there are "phylogenetic statements" in this book but most of these are *ad hoc*, without any particular evidence being specified, or they are statements of "nonrelationship." This situation does not speak well for the major purpose of the book, which is to summarize the history of birds.

As one might expect from the above comments, this book contains a host of unsupported speculations about the history of avian taxa. Whereas it is not always feasible to include much evidence in a book of this kind, it is appropriate for any attempt at serious scholarship to inform the reader—especially the naive reader—about the scientific status of these statements. Too often, phylogenetic assertions for which there is not a shred of evidence are presented without the slightest hint of caution. Some examples:

(1) "ancient gruiforms gave rise to many other birds, both living and extinct . . . and possibly to some of the ratites, including the ostrich" (p. 98). The basis for this statement is the presence in some members of the Ergilornithidae, an extinct gruiform family of Asia, of a foot with two toes (hence, the resemblance to ostriches). Left unstated is the considerable body of evidence that

this family is clearly gruiform and not related to ratites (Cracraft, *Bull. Amer. Mus. Nat. Hist.*, 151(1):73–77, 114, 1973; Kurochkin, *Smithsonian Contrib. Paleobiol.*, 27:81–85, 1976).

(2) “Additional shorebird derivatives include the sandgrouse, doves, and pigeons (Columbiformes), and through the toothed-billed pigeons, the parrots (Psittaciformes)” (p. 98). Although these taxa may have a close relationship, there is no evidence that “shorebirds” should be considered ancestral or that toothed-billed pigeons are more closely related to parrots than to other pigeons.

(3) “The hummingbirds’ true alliance may well be with the passerine birds, with which they share a number of important anatomical characteristics (Sibley and Ahlquist, 1972, pp. 200–205)” (p. 155). There is no mention of what these characteristics might be or why they might be considered “important” (are they synapomorphies?), and my reading of Sibley and Ahlquist (*Bull. Peabody Mus. Nat. Hist.* 39, 1972) fails to reveal their existence; indeed most of the literature summarized by Sibley and Ahlquist points to a relationship with swifts.

So, one of the serious problems of this book is that *many* phylogenetic and evolutionary statements are presented to the reader as if they were well established or noncontroversial rather than as the manifestations of a somewhat idiosyncratic view of avian history that they are. The excitement of reconstructing phylogenetic history—of proposing precise, testable hypotheses and then evaluating them—is not conveyed in these pages. There is, instead, a reliance on narrative scenarios, encumbered as they are by their baggage of untestable assertions about evolutionary process, adaptation, and transformationist views of ancestry and descent. It is my opinion that scenarios of this kind lie outside (or on the far fringes of) empirical science, because it is difficult to conceive of ways in which they can be objectively evaluated. The problem is not restricted to this book alone, but permeates much of evolutionary analysis. An example:

“it is not difficult to imagine the scenario in which flamingos could have evolved. The essential elements are highly colonial stiltlike shorebirds occurring on ancient lakes with the unsta-

ble salinity of those of the Green River System. Strong selective forces would have favored the evolution of long legs modified for wading into deeper water and, eventually, along with a myriad of other adaptations, the perfection of a suction filter-feeding mechanism that required great modification of the lower jaw to accommodate the large suction tongue of flamingos” (p. 95).

But we might ask, how can such a scenario be evaluated? The only potentially testable aspect is the vague statement suggesting an ancestral-descendant relationship between “stiltlike shorebirds” and flamingos. But how are we to investigate the nature of the natural selection that is said to drive the change? We cannot, of course. How are we to investigate the “perfection” of all these myriad adaptations? We cannot, of course. One fundamental error here is attempting to use within-population process phenomena to explain patterns existing between higher taxa. Furthermore, this transformationist scenario virtually denies the existence of taxa and the process of vicariance in the origin of those taxa: the animals just sit and transform. But what happens to the scenario if we “imagine” thousands of vicariance events between the putative shorebird ancestral *species* (in the singular) and the first descendant flamingo species? Given the potentiality for random directions in morphological change coupled with vicariance, what does this imply about the selectionist-adaptationist transformation? Namely, that it is essentially a figment of imagination. This same criticism can be directed at Feduccia’s scenario (based on Bock’s, *Syst. Zool.*, 14:272–287, 1965) about the origin of birds (and flight) from a ground-dwelling reptilian ancestor.

These are exciting times for the study of avian history. Some workers are attempting to break away from the older methodologies and to establish testable historical hypotheses based on sound comparative principles. This new approach to avian history is not reflected in Feduccia’s book, which relies on new data interpreted within an outdated theoretical framework. There are simply better methods in existence. Perhaps this book was written too soon.—*Joel Cracraft, Department of Anatomy, University of Illinois at the Medical Center, Chicago, Illinois 60680.*