Living Dinosaurs: The Evolutionary History of Modern Birds

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that smacks of "science by consensus," embodied by statements such as those by Henry Gee, a senior editor of the journal *Nature*, that "birds are dinosaurs: the debate is over," and Richard Prum's assertion that "it is time to abandon debate on the theropod origin of birds" (see p. 7). Rather, Feduccia urges for the application of the traditional approach of proposing and testing viable alternative hypotheses that are indicated by these emerging data, rather than shoe-horning them into support of the existing hypothesis. In *Feathered Dragons*, Feduccia provides the reader with a variety of compelling, but often ignored, data that are at odds with a derived theropod ancestry for birds. Among the examples of contradictory evidence that he showcases is the case of non-homology of the manual digits in theropods and birds—that although the three digits on the hands of theropods and birds often bear remarkable anatomical similarities, multiple developmental studies have indicated that the avian hand comprises digits 2, 3, and 4 whereas the generalized theropod hand is broadly acknowledged to be made up of digits 1, 2, and 3. To account for this discrepancy, bird–dino supporters have invoked a genetic frame-shift mutation that altered the identity of the digits, an unprecedented event in amniotes.

In another example of a report that strains credulity, Feduccia examines the claims of preserved soft tissues from a 75-million-year-old *T. rex* fossil. Several papers published in high-profile journals claimed to have recovered tissues including collagen, blood vessels, and even red blood cells from the femur of a tyrannosaurid, and to have extracted DNA that resembled that of birds—extraordinary assertions that made headlines. As Feduccia points out, follow-up analyses that cast serious doubts on these claims received little fanfare.

Feduccia also discusses the bombshell news from 1997, when the first of many "feathered theropods" began to emerge from China. These reports shook the scientific world and made headlines across the globe. These fossils were heralded as the final "nail in the coffin" for doubters of a close theropod–bird linkage. Feduccia provides a comprehensive treatment of the literature on the subject and shows that although many of the fossils are indeed feathered (and are also birds), a number of key specimens of more basal theropods described as "feathered" or "protofeathered" (i.e., possessing supposed simple filamentous integumentary fuzz) are in reality more likely to represent unusual preservation of dermal (within the skin) collagen fibers. These are just a few of the pieces of possibly dubious evidence that have been used to verify a dinosaurian ancestry for birds. Feduccia argues that these suspect studies should, at the very least, provoke a reexamination of the questions at hand.

Additionally, he provides an excellent treatment of the diverse fossils of enantiornithine (archaic "opposite" birds) and basal members of ornithiurine (modern) bird lineages from northeast China. He also evaluates a number of the curious, small dromaeosaurid microraptors, *Velociraptor*-like animals with arboreal adaptations (which included a perching foot and feathers forming wing surfaces on both fore- and hindlimbs). What to do with this avalanche of data? Feduccia urges that it be reanalyzed without a predetermined conclusion in mind.

That this controversy has become so bitterly fought is a bit of a wonder, in that both sides agree that birds and dinosaurs are closely related—the issue balances on when and where birds diverged from within the archosaurs. Thus, perhaps the most surprising suggestion Feduccia offers, and one that deserves a much longer look from anyone interested in these questions, is that data drawn from the myriad of new fossils could actually be turning conventional wisdom on its head (literally)—that is, the very birdlike dinosaurs such as the iconic 'raptors of Jurassic Park (e.g., *Velociraptor* and its relatives), the enigmatic troodontids, and the bizarre beaked oviraptorosaurs—long considered to be among the more derived theropods—are, in fact, members of an extensive adaptive radiation of volant and secondarily flightless birds! Those who have followed Feduccia's work over the years will recognize that this conclusion is a major shift in his views, and that his ability to deal with the new evidence in such an unbiased and creative manner is the mark of a uniquely sharp and innovative scientific mind. Whether one ultimately agrees with Feduccia or not, *Feathered Dragons: Hidden Birds of China* is a "must read" for anyone interested in these questions and will prod its readers to rethink received wisdom on the subject of the evolution of birds.—Nicholas Geist, *Department of Biology, Sonoma State University, 1801 East Cotati Avenue, Rohnert Park California 94928, USA. E-mail: nick.geist@sonoma.edu*

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Living Dinosaurs: The Evolutionary History of Modern Birds.—Gareth Dyke and Gary Kaiser, Editors. 2011. Wiley-Blackwell, Chichester, United Kingdom. xv + 422 pp., 8 color plates, 115 text figures, 5 tables, 5 appendices. ISBN 9780470656662. eBook 9781119990451. Cloth, $129.95.—This volume comprises 16 invited chapters authored by 29 contributors. As noted by the editors, the chapters represent "seemingly unrelated approaches to the study of avian evolution." The stated purpose is to "help bridge a gap that has developed between those who study birds as fossils and those who study the living animals." Once one gets beyond the inexplicable title and the first three chapters, to which I will return, one finds several interesting and thought-provoking chapters that work toward the editors' goal. Others are less successful.

The book is divided into four parts of unequal depth, with each chapter comprising a review of its topic. In this sense it is a useful tool, in that one can find an updated list of references for each topic, although the lists are often as notable for what is left out as for what is included. The three themes that I found most interesting are the reviews of specific avian groups, the evolution of certain avian traits, and the discussions of current methodologies for understanding avian evolution. Of the first, a review of the giant, presumably marine "pseudo-toothed," or "false-toothed," odontopterygiform birds by E. Bourdon and a review of penguins by D. Ksepka and T. Ando are highlights. Focusing on a cladistic analysis instead of possible life-history traits and functional morphology, the chapter by H. Alvarenga et al. on phorusrhacids, the "terror birds" of South America, is disappointing. Finally, F. Barker presents hypotheses of phylogeny and diversification of passerines, with a heavy emphasis on molecular models.

For the avian traits, S. Walsh and A. Milner provide a detailed and engaging review of the evolution of the avian brain and senses. A discussion of the brain of *Archaeopteryx* illustrates how far Jurassic birds had advanced from their nonvolant archosaurian ancestors. On the basis of avian brain anatomy, the authors even pose the question, which is novel for this volume, of whether some so-called theropods were really flightless birds. An elementary review of flight in modern birds is presented by B. Tobalske et al., with an unfortunate nod to the strange hypothesis that chicks of highly derived neornithine birds are good models for the evolution of flapping flight. C. Organ and S. Edwards review what they consider to be major events in avian genome evolution, while stressing that too few avian genomes are known to draw any conclusions regarding genome evolution in birds. B. Lindow reviews earlier papers that discuss avian evolution across the Cretaceous–Paleogene boundary but offers no new information or insights into this critical period of explosive avian diversification. A chapter by G. Kaiser on diversity in marine and aquatic birds is best avoided. G. Dyke and E. Gardiner discuss what the fossil record might tell us about when the neornithine radiation began, remarkably proclaiming that little progress in understanding avian evolution has occurred in the past 50 years!

The third theme is split between two parts of the book. On the one hand, the late B. Livezey provides a thorough evaluation of the contrasts and commonalities between morphological and molecular methodologies for arriving at avian phylogenies. As a counterpoint, J. Brown and M. Van Tuinen provide an overview of molecular phylogenetic dating techniques and their application to studies of neornithine origins and evolution. Ironically, both contributions, and other chapters in the book, tout rigorous phylogenetic analyses as key to constructing avian phylogenies while failing to recognize that both morphological and molecular phylogenetic methodologies are rooted in subjective decisions as to what is or is not important as data and how to interpret "characters." The rigor of subsequent analyses is in the eye of the beholder.

The book ends with a chapter on the state of the world's birds and the future of avian diversity by G. Thomas. The picture presented is that of a double-edged sword of human habitat destruction and climate change wreaking havoc on avian species diversity. Certainly, avian diversity faces a bleak and uncertain future, which is perhaps the most important reason for documenting current diversity and distributions to the maximum extent possible. Soon, the only records of too many modern species and the evolutionary history recorded in their genes will be limited to specimens preserved in museum collections.

To return to the inexplicable title and first chapters, although the BAD (birds-are-dinosaurs) hypothesis is de rigueur in some circles, there remains no meaningful, much less substantive or definitive, evidence that birds are derived from dinosaurs. The statement presented on the book's back cover that controversies over avian origins "have been swept away" is nonsense. Indeed, so many Mesozoic birds have been mistakenly characterized as theropod dinosaurs (e.g., *Caudipteryx*, *Microraptor*, and *Anchiornis*) that it will probably take decades to sort them out and arrive at an accurate picture of avian origins. This is not the place to enumerate the numerous faulty arguments upon which the BAD hypothesis is based, but because two are prominent in the first chapters, it might be informative to see just how obfuscatory characters purported to support the BAD hypothesis have become.

First, "dinofuzz" is a hair-like integumentary covering that is, as noted by P. Makovicky and L. Zanno, found in several dinosaur groups, and even pterosaurs. It is present on some theropods, so it is interpreted by BAD supporters as a precursor to avian feathers. Except in fertile imaginations, however, no transitional phases between dinofuzz and feathers exist, not even among the hundreds of splendid Mesozoic fossils from China. Integumentary coverings are not included in the "comprehensive" cladistic analysis of J. O'Conner et al.

Second, the homologies of the digits of the avian manus have been argued over seemingly forever. Recently, however, three different laboratories, working independently and with different techniques, demonstrated that avian digits are II-III-IV, not I-II-III as in theropods. Makovicky and Zanno perfunctorily dismiss these data, whereas O'Conner et al. acknowledge the possibility that II-III-IV is correct for birds, but strangely extend the II-III-IV enumeration to theropod dinosaurs. In their text and cladistic analysis, however, they treat the digits as I-II-III, which clearly corrupts their results. There are no functional similarities between the wrists of theropods and those of birds, so correctly identifying digit homologies is only one step toward a more accurate analysis.

Technically, the book is reasonably well produced. Nonetheless, there is an irritatingly large number of misspellings, missing words, and lapses in punctuation. Most of the illustrations of avian fossils are printed at such a small scale as to be of little value, which is unfortunate because they could have been very informative. Conversely, color figures are also presented in black-and-white in their respective chapters, and some figures appear three times. A glossary and index are included, although some of the glossary definitions are erroneous, which is bad for students.

All in all, the book might be useful for those who wish to keep abreast of various aspects of avian evolution, especially specialists in the field and those with specific interests in the topics covered. Given its relatively high cost and unbalanced presentation, I doubt that it will achieve the purpose for which it was intended. As J. Cracraft remarks in his foreword, the book might be a place for young investigators to get their feet wet, but I would caution them not to drink the water.—Kenneth E. Campbell, Jr., *Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, USA. E-mail: kcampbell@nhm.org*

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Boreal Birds of North America: A Hemispheric View of Their Conservation Links and Significance.—Jeffrey V. Wells, Editor. 2011. Studies in Avian Biology No. 41. Cooper Ornithological Society, University of California Press. 136 pp. ISBN 9780520271005. Cloth, $39.95.—The boreal forests of Canada and Alaska represent 25% of the earth's remaining intact forests, over half of the North American bird species breed there, and