Book Reviews

Particle Physics

Proceedings of the Eighth Hawaii Topical Conference in Particle Physics. Honolulu, Aug. 1979. V. Z. PETERSON and S. PAKVASA, Eds. University Press of Hawaii, Honolulu, 1980. viii, 638 pp., illus. Paper, $20.

The eighth and apparently last Hawaii Topical Conference in Particle Physics was held at a time at which it was becoming increasingly clear that the electromagnetic, weak, and probably even strong interactions are all described by gauge field theories. The discovery and detailed investigation of the weak neutral current interactions and of the charmed quark during the previous half dozen years had verified the low energy structure of the Glashow-Weinberg-Salam theory of weak and electromagnetic interactions and would lead to the awarding of the Nobel Prize in physics to those individuals shortly thereafter. During the previous decade a series of experiments in which electrons or neutrinos were scattered from hadronic targets or beams of electrons and positrons were allowed to annihilate had essentially established the existence of quarks, and in the summer of 1979 the first tentative evidence for the existence of the vector gluons that were widely believed to mediate the strong interactions had been reported.

The Hawaii conference occurred at the culmination of this extremely fruitful period. This fact along with the quality of the lectures makes this volume much more useful than most conference or summer school proceedings.

There are two theoretical lectures, by J. J. Sakurai and H. D. Politzer, which are devoted to quantum flavor dynamics (the weak and electromagnetic interactions) and quantum chromodynamics (the gauge theory of the strong interactions of quarks and gluons), respectively. Experimental lectures by G. Flügge and J. Steinberger are devoted to the description and interpretation of two of the types of experiments (electron-positron annihilation and neutrino scattering) that have contributed so much to our understanding of the basic interactions. These four lectures collectively describe most of the relevant phenomenological and experimental advances in particle physics in the last decade.

The lectures by Sakurai are an excellent introduction to the weak and electromagnetic interactions. The Glashow-Weinberg-Salam theory and the experimental status of the charged and neutral current interactions are described in detail. Possible alternatives to gauge models are discussed and expectations for future experiments are considered.

Unfortunately, the book does not contain a comparable introduction to the strong interactions. The lectures by Politzer assume that the reader already has a knowledge of quantum chromodynamics, deep inelastic scattering (some background on this topic is given in Steinberger's lecture), and heavy quark-antiquark bound states. The reader who possesses this background will find a useful series of critical discussions of the validity of various quantitative quantum chromodynamics tests. The factorization theorem is described in detail, and exclusive processes, sum rules, jets, bound states, $1/N$ expansions, and leading log calculations are considered.

Flügge's lectures describe most aspects of intermediate and high energy electron-positron annihilation physics. They include a very good balance of accelerator and detector properties, physics motivations, theoretical background, data, and results. The topics covered include tau lepton and bottom quark physics, top quark searches, quark and gluon jets, quantum electrodynamics tests, and two-photon processes.

Steinberger's lectures on topics in neutrino physics include descriptions of neutrino beams and detectors and of charged- and neutral-current neutrino scattering results. Considerable emphasis is placed on the use of neutrino scattering as a probe of hadronic structure, including tests of the quark-parton model and quantum chromodynamics corrections and measurements of the strange-sea component of the nucleon.

The lectures in this volume are highly readable. They could be read profitably by students (and by many workers in the field) to gain an overview of the status of the strong and electroweak interactions that covers current issues and expectations for the near future.

PAUL LANGACKER
Department of Physics,
University of Pennsylvania,
Philadelphia 19104

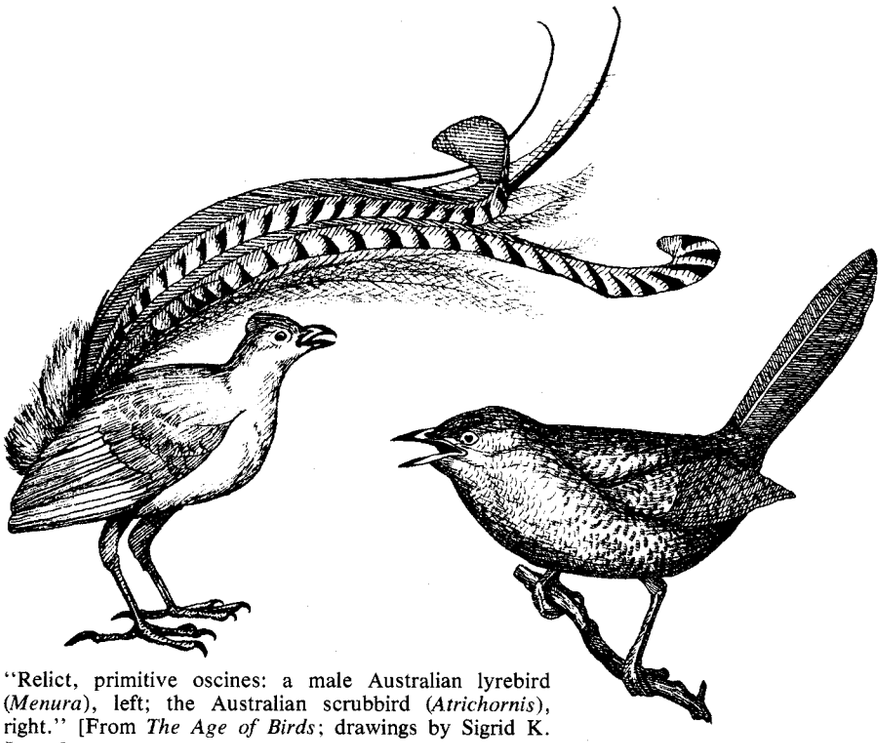
Avian Paleontology

The Age of Birds. ALAN FEDUCCIA. Harvard University Press, Cambridge, Mass., 1980. xii, 196 pp., illus. $20.

The past decade has seen an extraordinary growth in the contributions of avian paleontology to our knowledge and understanding of avian evolution. From a mere handful of dedicated paleornithologists who struggled for decades to develop the study of fossil birds, the field has recently grown to include numerous new workers who are approaching both old problems and new discoveries with fresh ideas born of a modern grasp of biological principles. The sudden large growth in our knowledge of fossil birds makes the appearance of this volume, summarizing as it does for the nonspecialist our current knowledge of the better-known fossil birds and avian evolution, most timely.

The first third of the book is devoted to what is known about the early stages of avian evolution. After a brief overview of the structural features of birds and a thorough, interesting history of the discoveries of all five specimens of *Archaeopteryx*, the questions of which reptilian group might have given rise to birds and how birds evolved feathers and the powers of flight are addressed. Feduccia handles such controversial topics well. Arguments supporting all sides are presented in such a way as to enable readers to draw their own conclusions or at least to pursue the subject in the literature. Nonetheless, after presenting all the evidence Feduccia states his own views straightforwardly. In most cases only additional research will provide definitive answers, but the summaries of current views should be welcome to those outside the field.

In the chapters that follow, the evolution of major avian groups is considered. In some chapters the treatment follows a traditional systematic approach—for example, the last chapter traces the rise of the numerous groups of land birds such



"Relict, primitive oscines: a male Australian lyrebird (*Menura*), left; the Australian scrubbird (*Atrichornis*), right." [From *The Age of Birds*; drawings by Sigrid K. James]

as the cuckoos, kingfishers, trogons, woodpeckers, and passerines. In this chapter, as in others, Feduccia briefly describes the fossil record for the groups in question and reviews the classic reasons for their position in the present system of classification. New lines of research, such as Feduccia's own on the avian stapes, and what they suggest about the evolution of birds are also discussed briefly.

One of the more interesting examples of how the study of fossil birds is altering our perception of avian evolutionary relationships is found in the chapter "Shorebirds, ducks, and waders." Here Feduccia relates how the discovery of abundant Eocene bird fossils referable to the genus *Presbyornis* has helped clarify our understanding of the relationships between shorebirds, ducks, and flamingos. The study of *Presbyornis* has provided a reasonable explanation of how ducks may have evolved from stilt-legged shorebirds, and, moreover, Feduccia's account details the type of sleuthing carried on by paleornithologists who must determine the relationships of fossil birds that may have characters found in several disparate modern groups.

The longest chapter in the book is devoted to one of the most discussed, and disputed, topics in ornithology: the evolution of flightlessness in birds. All major fossil and extant groups of flightless birds are reviewed, as is the matter of whether the flightless ratites are monophyletic or polyphyletic. Feduccia also explains why, in his view, flightlessness develops through neoteny. Though no definitive new evidence bearing on the numerous questions about ratites is offered, the material presented does explain to the nonspecialist what the arguments are all about.

The book is well designed and almost error-free, but the lack of metric equivalents will no doubt prove an annoyance to some readers. And one could wish that the current practice in ornithology of capitalizing the common names of living birds had been followed. Unfortunately, the abundant illustrations are of variable quality. In some of the line drawings detail has been lost in the reproduction, and, though some of the photographs have excellent reproduction, most seem rather muddy. The heart of any book, however, is the writing, and in this case it is of an overall high standard. In writing *The Age of Birds* Feduccia "tried to tell the story of the evolution of birds in a way that will appeal to people of diverse interests." Although such a book is perforce limited in depth and breadth and tends to be biased in coverage toward those topics most familiar to the author, this volume should prove to be of interest to anyone interested in the evolution of birds, and paleontology in general.

KENNETH E. CAMPBELL, JR.
Natural History Museum of
Los Angeles County,
Los Angeles, California 90007

Evolutionary Physiology

Comparative Physiology: Primitive Mammals. Papers from a conference, Crans-sur-Sierre, Switzerland, June 1978. KNUT SCHMIDT-NIELSEN, LIANA BOLIS, C. RICHARD TAYLOR, P. J. BENTLEY, and C. E. STEVENS, Eds. Cambridge University Press, New York, 1980. xiv, 338 pp., illus. $44.50.

The topic of this book is the physiology of extant mammals that are the descendants of "primitive" or "conservative" groups that appeared early during mammalian evolution. These naturally include monotremes, marsupials, and insectivores. Other groups such as edentates and primates are also discussed. Four major aspects of physiology are considered: thermoregulatory energetics and the evolution of endothermy, locomotory energetics and biomechanics, digestive anatomy and physiology, and endocrinology. Although the book is not uniformly successful in elaborating these themes, it presents front-line research and thought by the major workers concerned with them. It is the first such compendium of work on these diverse groups of animals and will be of interest to comparative physiologists, paleobiologists, and general vertebrate biologists.

The concept of primitiveness haunts the book, and its meaning is never resolved. It is used in various places to indicate only that a character is presumed to have appeared early during mammalian evolution. Elsewhere it is meant to indicate that a character is less developed or perfected. For instance, is egg-laying by monotremes primitive? Yes, in the sense it is ancient, and no, in that it appears perfectly adequate as a reproductive mode. This confusion leads to a proliferation of terminology (primitive and advanced, conservative and derived, plesiomorphic and apomorphic) that is not uniformly applied and is consequently unhelpful. Since these issues are not disposed of centrally, each author must struggle with his or her own definitions. Some of these are unsophisticated, and an evolutionary biologist may find much to quibble with in some of these papers.

Ideally such a book should have several purposes: description of the physiology of a collection of extant mammals related to early-derived groups; generalization of the individual physiological patterns; and speculation on the course of evolution of physiological capacities. The first goal is reasonably well met in this book. Considerable information has now been obtained on these previously neglected mammals. In some cases this