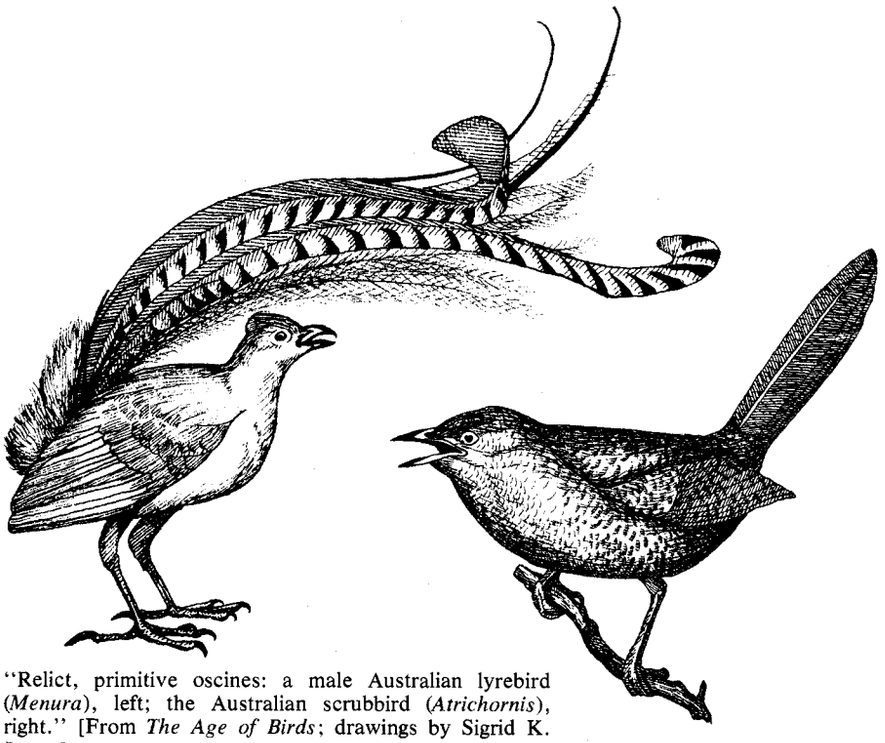

"Relict, primitive oscines: a male Australian lyrebird (*Menura*), left; the Australian scrubbird (*Atrichornis*), right." [From *The Age of Birds*; drawings by Sigrid K. James]

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.

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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

information is more detailed than that available for nondomesticated eutherians, and the book will be an important reference source and literature key to the physiology of these groups. In its pursuit of the other goals, the book is understandably less successful. Primitive mammals as a group have either too much or too little physiological diversity to permit easy generalizations. As examples, the authors in the locomotory and endocrinological sections uniformly agree that no major common features separate primitive from advanced mammals. In contrast, the metabolic energetics and digestive physiology of individual species are so diverse even within restricted groups of primitive mammals that it is impossible to sort primitive from derived features. One of the authors likens attempting to visualize the course of mammalian physiological evolution by examining one species after another to painting a tree one leaf at a time. This volume contains many well-drawn leaves and a few twigs, but the tree is still vague. The grand syntheses do not emerge, and it is not for the customarily offered reason that too few species have been examined. Comparative physiology alone will evidently not answer questions concerning the evolution of primitive mammals.

The most extensive and interesting section concerns metabolic level and thermoregulation. Although many primitive mammals maintain a lower body temperature (28° to 35°C) than do advanced eutherians (37° to 40°C), both groups remain good homeotherms when confronted with thermal stress. The unanimous conclusion of the authors is that these thermoregulatory systems are not primitive in the sense of being inadequate. Whether low body temperatures and low metabolic rates were traits possessed by early mammals is more controversial. C. R. Taylor maintains that these are in fact primitive features in this sense. Other authors (T. J. Dawson, A. J. Hulbert, A. Shkolnik) point to diversity of metabolic level within individual groups of primitive mammals as a factor that complicates generalization. It was once held that metabolic rate and thermoregulatory ability both increased during the sequential evolution of the monotremes, marsupials, and then placentals. This view has been abolished by recent data, but it has not been replaced by a similarly simple and beguiling pattern.

Many of the papers concerning locomotion touch only briefly on primitive mammals. Hopping in kangaroos receives much discussion, but this is of course not a primitive feature. The general conclusion is that these mammals do not show primitive locomotory traits and are not distinguishable from advanced placentals in such features as locomotory efficiency, elastic energy storage in muscle and tendon, or muscle fiber type.

The sections on digestion and comparative endocrinology are less satisfying. The papers on the structure of the digestive systems are good introductions, but those dealing with digestive physiology concentrate too heavily on individual species and on a single function (passage time). Little synthesis is attempted. The endocrinological papers are dense compilations of experimental results with little explanation or interpretation for nonendocrinologists. The significance of the conclusions is generally not made apparent (except in the chapter by P. J. Bentley). I expect that the papers in both these areas will be of interest to specialists but not to other comparative physiologists.

The book is generally well written, given the difficulties of getting 40 authors to move in the same direction at once. Some of the chapters are truly excellent, particularly those of A. W. Crompton, H. C. Heller, and A. J. Hulbert, being brief, informative, and provocative all at once. This is a useful compendium of information on diverse groups of mammals, the physiology of which is rarely discussed in more general texts.

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Shallow-Water Ecosystems

Marine Benthic Dynamics. Papers from a symposium, Georgetown, S.C., April 1979. KENNETH R. TENORE and BRUCE C. COULL, Eds. Published for the Belle W. Baruch Institute for Marine Biology and Coastal Research by University of South Carolina Press, Columbia, 1980. xx, 452 pp., illus. $27.50. Belle W. Baruch Library in Marine Science, No. 11.

The importance of the benthic community as a component of estuarine and coastal marine ecosystems cannot be overemphasized. The cycling of material through the benthic system is directly coupled with the productivity of these ecosystems, and an understanding of such processes is paramount in evaluating the effects of the anthropogenic and natural perturbations routinely imposed on them. This symposium volume presents a compilation of recent thinking regarding the dynamics of shallow-water, soft-bottom benthic communities and provides a much-needed update on this rapidly expanding field of study. Although many of the processes discussed also occur in deep-sea and hard-substrate communities, such communities are largely ignored.

One significant but largely unknown factor in the cycling of nutrients through the benthic community is the rate of anaerobic metabolism. Pamatmat has painstakingly developed a direct calorimetry method to evaluate the importance of this process in several species of benthic macrofauna. Application of this technique to a wide variety of benthic organisms and the community as a whole will provide necessary information regarding these rates and the importance of anaerobiosis in the overall dynamics of this system.

Bell and Coull examine the interaction of two significant groups of benthic organisms, the juvenile macrofauna (temporary meiofauna) and the permanent meiofauna. Their exploratory experiments have shown that the meiofauna have a significant adverse effect on recruitment of the macrofauna. Such interactions must be considered in evaluating rates of population recruitment and mortality.

Nixon and associates report seasonal data indicating that one nutrient cycle, that of phosphate, is dominated by sediment-water exchanges. In a unique cross-fertilization of geochemistry and biology, Aller has examined the importance of tube-dwelling macrofauna on the fluxes of nutrients across the sediment-water interface. He reports that the activities of these animals and their burrows significantly influence the flux rates of various nutrients.

Another stimulating paper in this volume is that of Hobbie and Lee, who present the novel hypothesis that extracellular mucopolysaccharides produced by microbes, and not the microbes themselves, constitute the most important food source for many benthic animals. In examining the interaction of microorganisms and infauna, Yingst and Rhoads present an equally exciting hypothesis that faunal bioturbation of the sediments stimulates bacterial growth, which in turn enhances the food supply of the bioturbating animals.

Among the other 17 contributions to the volume are thought-provoking reviews of secondary production (Warwick), population and community patterns (Dayton and Oliver), fluxes and utilization of organic matter (Hargrave), and availability and utilization of detritus (Tenore and Rice).