students in biochemistry, pharmacology, toxicology, or related fields. For seasoned investigators, as well as for students, this reviewer recommends this work highly.

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Tupaiidae

Comparative Biology and Evolutionary Relationships of Tree Shrews. W. PATRICK LUCKETT, Ed. Plenum, New York, 1980. xvi, 314 pp., illus. $39.50. Advances in Primatology.

The tree shrews, a close-knit family of squirrel-like mammals inhabiting South and Southeast Asia, were rescued from obscurity by LeGros Clark's studies (1924–1932) indicating phylogenetic association with the primates. This interpretation received support in Simpson's influential classification of the mammals (1945) incorporating the tree shrew family Tupaiidae in the order Primates—an allocation soon widely accepted. Over the past 15 years, however, suspicions have grown that tree shrews are not close relatives of primates after all, and the present consensus is that they constitute a separate order (Scandentia). The time is ripe for a comprehensive review of tree shrew affinities, and Luckett's edited volume substantially meets this need.

The reappraisal of tree shrew phylogenetic relationships has resulted partly from a flow of new data, often revealing significant differences between tree shrews and primates. There have also been many corrections of errors in earlier reports. More important, though, has been the revolution (to some extent inspired by Hennig) that has affected procedures used for phylogenetic reconstruction. It is now generally accepted that mere listing of apparent homologous characters does not suffice to reveal relationships. For any group considered one must distinguish between primitive (symplesiomorphic) homologies retained from the initial ancestral stock and derived (synapomorphic) homologies retained from any later stock. The overwhelming conclusion that emerges from this book is that reanalysis of the undoubted similarities between tree shrews and primates identifies most of the shared features as characters retained from the ancestral placental mammals, while the remainder probably involve convergence.

Other procedural inadequacies in earlier assessments of tree shrew relationships included inadequate representation of different placental mammal groups, limitations both in the numbers of characters considered and in the depth of analysis (for example, omission of embryological information), neglect of variation within the Tupaiidae, and internal inconsistencies in proposed phylogenetic schemes. These inadequacies have been overcome to varying degrees in the contributions to Luckett's book, and the revision of tree shrew relationships thus represents a genuine advance in scientific knowledge rather than just a fashionable swing in opinion.

A useful historical introduction is provided by Luckett, and well-balanced accounts of cranial morphology (Novacek; Cartmill and MacPhee), central nervous organization (Campbell), and reproductive biology (Luckett) place in modern theoretical perspective many of the key characteristics originally thought to link tree shrews with primates. The treatments by Novacek and by Cartmill and MacPhee of orbital and basicranial characters overlap considerably, but it is encouraging that broadly similar conclusions emerge. Strangely, despite traditional reliance on dental morphology in mammalian phylogenetic reconstructions, no adequate case was ever made for significant dental resemblances between tree shrews and primates, and Butler's chapter on tree shrew dentition expertly shows that no case exists. One major drawback has been, and remains, the absence of convincing early fossil tree shrews. We now have some fragments documenting the presence of tree shrews in India some 10 million years ago, but unfortunately Jacobs's chapter predated the recent reports of the most substantial specimens by Vasishat, Chopra, and Kaul. Discussions of postcranial features by Szalay and Drawhorn and by Novacek are incomplete and do not rigorously distinguish primitive from derived conditions. Szalay and Drawhorn's analysis of the tarsus is weakened by reliance on unassociated fossil specimens and concomitant circularity. Worse, the only known associated European adapid postcranial skeleton (recently described by von Koenigswald) throws doubt upon the identification of isolated tarsal specimens as "*Adapis parisiensis*" and thus upon the entire analysis. All of these chapters on morphological criteria suffer from a lack of quantification and, in particular, from neglect of allometric effects—so further work remains to be done.

The relatively new approach of tree-building with the use of quantitative data from immunological cross-reactions and protein sequencing is covered in two chapters (Dene *et al.*; Cronin and Sarich). Such studies add a valuable new dimension to phylogenetic reconstruction, but immense problems are raised by gene duplication, by generation of numerous alternative trees with only marginal differences in "parsimony," and by use of antiserums produced in a mammal (rabbit) to assess mammalian evolutionary relationships. Further, molecular information has yet to be successfully integrated with classical morphological data.

The total evidence in this book discounts any close relationship between tree shrews and primates, but there is no clear consensus concerning relationships between mammal orders. Some authors favor a modification of Gregory's "Archonta" (primates; tree shrews; elephant shrews; bats; flying lemurs), whereas others see this group as united only by shared primitive placental mammal features. Resolution of mammal interordinal relationships must await a proper synthesis of available data from all sources, and the tree shrews will doubtless continue to serve as a suitable test case.

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A Study in Paleoecology

Lower Wenlock Faunal and Floral Dynamics. Vattenfallet Section, Gotland. VALDAR JAANUSSON, SVEN LAUFELD, and ROLAND SKOGLUND, Eds. Geological Survey of Sweden, Uppsala, 1979. 294 pp., illus. Paper, $19. Sveriges Geologiska Undersökning Series C NR 762.

This important advance in the study of paleoecology goes far beyond the rather superficial counts of fossils exposed on bedding planes that characterized many of the early efforts in the field. Merely suggesting the inadequacies of previous attempts, it provides a procedural model for future paleoecologic studies—a model that may save workers in the field much time, many mistakes of omission, and not a few of commission. The editors have coordinated a remarkable effort by 32 specialists from eight countries to provide an account of the paleontological dynamics of a single thin mid-Silurian section. They call this study "the first ever attempt to elucidate the succession of all fossil organisms during an interval