Evelyn Hutchinson might indulge in himself. Its actual reference is to the development of ecological theory, in which Hutchinson and his students have had an eminent share. Deevey's preface also warns: "To describe the contents of this volume seems to require a tedious and most un-Hutchinsonian disquisition, on the nature of modern ecology." The varied diet in this volume does more, but also less, than this. It allows one to savor, at one step removed, many of the interests that have occupied an active career. Through an afterword by S. D. Ripley, it even allows a fleeting, more personal glimpse of some early episodes in it, the African and East India expeditions, which exerted a lasting influence. A further personal touch is provided by Rebecca West's charming portrayal of an utterly unimportant, but revealing, episode from her acquaintance with Hutchinson.

The rest of the 20-odd papers are more traditional, though their range is formidable and characteristic. Perhaps most in keeping with Hutchinson's style is E. Leigh's article on the significance of the angular arrangement of leaves around the stem, which has evolutionary implications that go beyond the author's evident enjoyment of the mathematics and geometry. Other scenes from the evolutionary play have been chosen by a major fraction of the authors, among them the Browers, M. J. Dunbar, I. McLaren, L. B. Slobodkin, and P. Wangersky. There are papers on the history of science (J. L. Brooks and E. Mills) and of a lake (M. Tsukuda). Two papers are primarily taxonomic, with that by Hartman and Goreau having important paleoecological implications. D. Zinn and S. Kahn's account of the geography and geology of Penikese Island approaches Hutchinson's geological interests, though their compass is far narrower. Curiously and unfortunately, biogeochemistry receives no emphasis in the entire volume, nor is its treatment in the recent issue of *Limnology and Oceanography* honoring Hutchinson commensurate with the importance of this field among his endeavors.

Of the essentially solitary forays, P. Klopfer's examination of the origin of human consciousness and U. Cowgill's discussion of seasons of birth and death of man in Portugal are worth singling out. The latter also provides an unconscious (I think) bit of humor with a statement about the temporal sequence of birth rates, "Minima appear alternately around the maxima."

The rest of the papers are on aspects of ecological theory whose relations are becoming increasingly clear: diversity, species interactions, and ecosystem stability. R. Margalef, in a vast generalization, suggests that diversity in nature rarely exceeds 5 bits per element. A. Covich shows some of the advantages and difficulties of applying economic models to exploitation as practiced by organisms other than man, and F. Smith examines the conditions for ecosystem stability, using computer simulations as a tool. He concludes by returning to one of Charles Elton's rather neglected insights, that spatial heterogeneity seems a prime requirement for stability.

A number of the contributions are undoubtedly important, perhaps some I have not discussed. In sum, they do begin to suggest the variety of one's experience in becoming acquainted with G. E. Hutchinson. Still, reading most of them one longs for the felicity of his prose and the fertility of his imagination.

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Primates in Natural Groups

The Social Behaviour of Monkeys. THELMA ROWELL. Penguin, Baltimore, 1973. 204 pp., illus. Paper, $2.50. Penguin Science of Behaviour series.

Thelma Rowell has written a very interesting and stimulating little book about the social behavior of monkeys. Concerning herself primarily with data from the Old World monkeys, she has produced a volume which challenges some old ideas, presents some new theories, and effectively communicates the complexity of nonhuman primates and their social systems.

The brief opening chapter introduces the primates and puts their behavior and organization into perspective by comparisons with other social mammals. Rowell then presents a general account of the behavior of the wild baboons (*Papio cynocephalus*) which she studied on the Uganda side of the Ishasha River. Among the more interesting conclusions drawn from the field study (many of which contrast with those from other studies of feral baboons) are that adult females serve as a focus of the group's social activity, and that they "lead" the group in the sense of selecting the direction for the day's march; adult males change groups frequently, and the stable core of a group is the subset of adult females; the adult males of the Ishasha troops were not arranged in dominance hierarchies; and adult males failed to defend the troop against external threat, choosing rather to lead the retreat.

The Ishasha study then serves as reference data for expanded discussions of several major areas of primate behavior and organization. These include communication, sexual behavior, infant social development, and the effects of environment on behavior. All are areas of personal research for Rowell, and the chapters are excellent. I was particularly pleased with the discussion of mating and estrus. Rowell appreciates and communicates to the reader the intricate interplay of variables which combine to produce mating behavior. One of her conclusions which I wish to underscore is that for many primate species estrus and mating can and do occur at times other than proximal to ovulation. This fact necessitates a bit of rethinking by primate researchers accustomed to equating estrous cycles and menstrual cycles.

A chapter on adult behavior includes discussions of dominance hierarchies, territory, social roles, and the ways kinship and age affect behavior. I must take issue with Rowell on the topic of dominance hierarchies. I think she is overstating her case when she suggests that a hierarchy may be a "pathological response" to stressful conditions. At present, too little is known about the formation, maintenance, and functioning of dominance hierarchies to warrant labeling them pathological. In fact, such a label could provide an excuse for the termination of research into the phenomenon of hierarchical dominance systems—an effect which Rowell would detest, I am certain.

The book is good, and I heartily recommend it. Surely one of its best points is the evaluation of old theoretical approaches and the presentation and discussion of new ones. Toward the end of the book is a statement which will please those readers who believe (as I do) in the value of longitudinal studies of groups containing individuals of known relationships. Rowell says, "I would predict that kinship

will prove to be the most important key to understanding social organization of natural groups of monkeys, and that its study will well repay the rather formidable practical problems involved in maintaining any really long-term study." The widespread acceptance and application of this idea will mark the beginning of a new era of primate studies.

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Historical Zoogeography

Evolution, Mammals, and Southern Continents. ALLEN KEAST, FRANK C. ERK, and BENTLEY GLASS, Eds. State University of New York Press, Albany, 1972. 544 pp., illus. Cloth, $17.50; microfiche, $12.50.

A little over a century ago J. Wagner (remembered today for his description of the earliest known bird, *Archaeopteryx*) pinpointed a mountain in northeast Turkey, Büyük Agri Dag, as the site from which the mammals radiated. Wagner regarded this twin-peaked mountain, known today as Mount Ararat, as the final resting-place of Noah's ark.

Historical biogeography has come a long way since Wagner's time. By the middle of the present century P. J. Darlington (*Zoogeography: The Geographical Distribution of Animals*, Wiley, 1957) was able to formulate a general theory accounting for the origin and dispersal of vertebrates on a global scale. He suggested that the major vertebrate groups, including mammals, had originated in the "Old World tropics" and that successful groups dispersed from there: to Australia, to Africa, to Eurasia, and thence across the Bering land bridge into North and subsequently South America. Ancient relics on the other hand would survive at the "ends of the earth," having been replaced by more advanced forms at their center of origin. This widely accepted hypothesis was based on a model of the world as changing endlessly in detail but fixed in its main pattern of land and climates. Following W. D. Matthew and G. G. Simpson, Darlington rejected Alfred Wegener's hypothesis that the continents had moved with respect to one another.

The revolutionary development of plate tectonics theory during the past 15 years now renders static global models, and evolutionary schemes based upon them, obsolete. Hypotheses that visualized the radiation of most vertebrate groups from the "Old World tropics" and the survival of relics in the geographic cul-de-sacs of Africa, Australia, and South America are now undergoing extensive revision.

This collection of review articles on the evolution of mammals on the southern continents is one of the first volumes on historical biogeography to appear since continental drift became a fact of paleogeography. Containing generally excellent essays on fossil and contemporary mammals of three continents, the book will be useful to vertebrate zoologists and others interested in the interaction of organic evolution and paleogeography. Although earlier versions of these essays were published separately in the *Quarterly Review of Biology* (September 1968 through June 1969, December 1971) the collection is worth reviewing here as it confronts the major problems of historical and evolutionary biogeography.

Biologists have long been intrigued by the concentration of primitive mammals in the three widely separated southern continents. These strikingly different (except for the cosmopolitan rodents and bats) faunas display remarkable structural and ecological convergence. Australia is characterized by marsupials and egg-laying monotremes; South America by a mixture of placentals and marsupials; and Africa by placentals only. The six descriptive essays on the fossil and contemporary mammal faunas of these continents constitute the most valuable portion of this book. The major fossil localities and their faunas are reviewed authoritatively; patterns of radiation, distribution, ecology, and evolution are described family by family. The text is enhanced by numerous illustrations of living and extinct forms and by extensive bibliographies. The indexes are excellent.

H. B. S. Cooke describes the fossil mammals of Africa and their paleoenvironments. He shows that, far from being a refuge for the survival of archaic forms, the continent has been an important center of mammalian evolution. Several successful groups, including man, have dispersed to other parts of the world. The contemporary mammals of Africa are reviewed from systematic and regional viewpoints by R. C. Bigalke.

The peculiar character of the Australian mammal fauna was aptly summed up by Darwin when (lying on a sunny river bank in 1836 and reflecting on the Paradox, as the platypus was then called) he wrote: "An unbeliever in everything beyond his own reason might exclaim 'Surely two distinct creators must have been at work. . . .'" Keast capably summarizes our knowledge of this fauna, about whose phylogeny and late Cenozoic history we have learned much in the past decade, but about whose early history we still know nothing. Far from being "living fossils," the Australian marsupials are actively evolving and speciating.

The two chapters on South American mammals are outstanding, and are especially instructive because their authors disagree on several issues. B. Patterson and R. Pascual, writing about the fossil faunas, hold that the original Mesozoic stocks (marsupials, edentates, ungulates) and the early Tertiary immigrants (rodents and primates related to African groups) arrived by island-hopping from North America. P. Hershkovitz, in contrast, raises the possibility that the primitive marsupials originated on Gondwanaland and moved between the then-joined Australian-Antarctic continent and South America by way of the Scotia Arc. As for the rodents and primates, he suggests their probable derivation directly from Africa as the South American and African plates rifted apart. A third controversy concerns the onset of the large-scale faunal interchange between North and South America that has traditionally been linked to the appearance of the Panamanian land bridge toward the end of the Pliocene. Although these issues cannot be settled yet, Patterson and Pascual rightly note that there is little fossil evidence to support Hershkovitz's more speculative views on the fauna's history.

Mammals arose about 200 million years ago, at a time when the Mesozo-