is too bad that none of the Russian literature on echolocation is included, and it would seem appropriate to elaborate more on some topics such as the ultrasonic communication and ontogeny of echolocative pulses in infant bats. The brief appendix might also be profitably expanded to further assist those unfamiliar with the application of information theory to animal sonar systems. Nevertheless, Sales and Pye have achieved a reasonably balanced and complete coverage of their subject within the restrictions of a limited space. Their authoritative and readable book will be much appreciated by all who are interested in bioacoustics.

RODERICK A. SUTHERS
Department of Anatomy and Physiology, Indiana University, Bloomington

The New Paleoprimatology

Approaches to Primate Paleobiology. F. S. SZALAY, Ed. Karger, Basel, 1975. x, 326 pp., illus. Paper, $60.25.

Paleobiology and its glamorous sister group paleoanthropology are essentially empirical sciences. Recently, however, their practitioners have applied a veritable battery of new and refurbished techniques, methods, and inferential strategies to the stock-in-trade of their realms, the fossils. "Approaches" is indeed appropriate in the title of this nine-chapter volume. It exemplifies the new paleoprimatology.

Savage (p. 15) looks forward to a halcyon period in which sophisticated geochemical-geophysical methods will permit paleontologists to withdraw their fossils from a central position in geochronological dating and to concentrate instead on paleobiological puzzles. He provides many clearheaded caveats for orthodox practice during the interim.

Russell epitomizes the faunas and environments of four Paleocene localities and more numerous (over 50) early Eocene sites in Europe. Very few European Paleocene forms persisted into the early Eocene, which was characterized by many new types of animals. Russell concludes that only a "mass migration" via a land connection with North America reasonably explains this faunal transition. Europe and North America had more than 50 percent of genera in common during the early Eocene whereas only 20 percent were identical in the late Paleocene (p. 43).

Andrews and Van Couvering's open-minded essay on paleoenvironments and pongid distributions in the East African Miocene is a provocative contribution to paleoanthropology. Around 16 million years ago Africa rejoined Eurasia, great faunal interchange occurred, volcanic activity produced prominent altitudinal relief in East Africa, and lakes formed in the Eastern Rift (pp. 69–70). Montane forests developed on the upper slopes of the volcanoes (p. 77) and inter-rift evergreen forests gave way to a greater complexity of vegetation types.

Andrews and Van Couvering disagree with hypotheses directly linking *Dryopithecus africanus* and *Dryopithecus major* with modern chimpanzees and gorillas, respectively. They speculate that the East African Miocene apes represent adaptive radiations into ecological niches now occupied by monkeys (pp. 92–93). The validity of Andrews's two "new" species of *Dryopithecus* (*D. gordoni*, represented by 24 individuals, and *D. vancouveringi*, represented by seven) remains to be substantiated by detailed morphological treatises (perhaps à la Ramaekers, Delson, and Eldredge and Tattersall, this volume). If they are in fact referable to established species of *Dryopithecus* (and perhaps *Limnopithecus*) then, *pace* Andrews and Van Couvering (p. 97), *D. africanus* might be safely returned to the forest.

Delson's handsomely illustrated paper on the evolutionary history of the Old World monkeys clarifies the positions of many species. It is based on a study of numerous fossils, interpreted by a cladistic approach emphasizing shared derived characters. Delson concludes that the adaptive radiations of the Colobinae and Cercopithecinae were geochronologically relatively late events (beginning about 12 million years ago). He also constructs hypothetical craniodental morphotypes for each major ancestral population.

Three chapters (Eldredge and Tattersall, Gould, and Every) contain applications of novel approaches to aspects of hominid evolution. For instance, at the conclusion of a lengthy discussion on allometry and brain evolution in primates and the types of scaling that might provide information on evolutionary mechanisms, Gould resurrects the pedomorphic theory of human origins, swaddled in the concept that ontogenetic scaling reasonably explains the outsized human brain.

RUSSELL TUTTLE
Department of Anthropology, University of Chicago, Chicago, Illinois

Do Ecosystems Converge?

Mediterranean Type Ecosystems. Origin and Structure. FRANCESCO DI CASTRI and HAROLD A. MOONEY, Eds. Springer-Verlag, New York, 1974. xii, 406 pp., illus. $30.10. Ecological Studies, vol. 7.

Five fairly localized regions of the earth's surface share an unusual unimodal annual precipitation regime with moderate winter rainfall but a pronounced and prolonged summer drought. These areas lie mostly between latitudes 30° and 40° on the western sides of continents. They are widely separated geographically, not only being scattered all around the Mediterranean Sea but also occurring along the southern edges of both Africa and Australia and in central Chile and parts of California. Unimodal annual marches of precipitation occur elsewhere, but with the wet season invariably during the warmer months. A result of the unique "mediterranean" climate is that the seasonal difference between winter and summer is accentuated. As might be expected, these extraordinary spots typically support a drought-resistant, evergreen, and tough-leafed vegetation, often termed chaparral. Although they tend to have basically similar life forms, the actual species of plants differ between regions.

The present compendium is an outgrowth of a symposium held in Chile in 1971. It is mainly an attempt to discern whether these various mediterranean systems originated and evolved independently of one another, and, if so, to assess the extent to which their structure and function might have converged over evolutionary time. If present, such a convergence in ecosystem structure and function would indicate the degree to which evolutionary pathways are predictable and determinate. Ecosystem convergence is an attractive prospect in that convergent responses to similar selective pressures would encourage ecologists in their continuing quest for general principles of community organization.

Natural selection does not act upon entire ecosystems but operates through differential reproductive success of individual organisms within communities. Organisms living in an ecosystem often evolve in response to antagonistic counteradaptations of other organisms, such as their predators and competitors. Coupled with accidents of history, such biotic interactions must of-

ten shape community structure in important, but unpredictable, ways. Animals at higher trophic levels might be expected to reflect such biotic interactions more strongly than those at lower trophic levels. Comparing communities and ecosystems is a subjective business, and it is tempting to emphasize similarities while playing down inexplicable discrepancies.

Although admittedly preliminary and somewhat restricted in scope and coverage, the book does describe many aspects of the histories, climates, soils, and vegetation of the five mediterranean regions. Limited information is provided on some of their faunas. The Chile-California comparison is dominant, but the other three regions are also considered frequently. Two short concluding chapters briefly examine the enormous impact man has had on these very fragile ecosystems, all of which have been extensively disturbed. The 22 chapters are as varied as their 24 authors: some are carefully done and others pedestrian and poorly written. None of the chapters struck me enough to single out as representative of one or the other end of the continuum. The book is nicely printed, but riddled with typographic errors. Editorial effort appears to have been minimal.

Evidence for an independent origin of each of the five areas is reasonably convincing. On a geological time scale, their peculiar climate is probably fleeting and of relatively recent origin. In California, Axelrod indicates that summer rainfall, as well as the annual total, probably decreased rather gradually over the last 60 million years as the average temperature of Pacific surface waters fell. Total summer drought presumably did not occur until the Quaternary, about a million years ago. Most woody perennial plants that now occur in these communities seem to be drought-resistant species that were able to persist under a summer drought, winter rainfall regime. Herbaceous and annual species, however, apparently evolved rapidly in response to changing climatic conditions, for many appear to be endemic to the areas concerned. The major conclusion to be drawn from historical evidence seems to be that mediterranean regions constitute a convenient "natural" experiment which can be used to follow the independent development of natural communities subjected to a similar physical environment over an evolutionary time period of a million years.

In almost every aspect of ecosystem structure or function examined, some intriguing discrepancies between systems are evident. For example, the beginnings of the arid and humid periods in Chile tend to occur earlier than their analogs in California. Turnover in the composition of the avifauna is greater between adjacent habitats in California than it is in Chile.

Similarities between these two systems also abound: plants tend to have similar growth forms, soil organisms tend to occur deeper than in nonmediterranean ecosystems, and ecologically homologous bird species are recognizable (though often with subtle ecological differences between them). However, most such similarities are hardly very surprising in view of the strong similarities in the physical-chemical environments of mediterranean ecosystems.

In general, I found the case for convergence rather subjective and somewhat overworked. A great deal remains to be learned about these mediterranean ecosystems, let alone the broader subjects of community structure and ecosystem convergence.

ERIC R. PIANKA
Department of Zoology, University of Texas, Austin

The Zambezi Impoundment

Lake Kariba. A Man-Made Tropical Ecosystem in Central Africa. E. K. BALON and A. G. COCHE, Eds. Junk, The Hague, 1974. xii, 768 pp., illus., + maps. Dfl. 210. Monographiae Biologicae, vol. 24.

The large man-made lakes of tropical Africa, conceived in support of industrial development, have brought severe sociological stress to the peoples they have displaced. Largely to minimize these human dislocations, but also to increase basic protein production, African governments have attempted to stimulate commercial fishing on each of these lakes. Drawing on external, chiefly United Nations, resources, they have devoted considerable amounts of money and manpower to hydrobiological research and fisheries development. Although the expectations for development have not been realized, the basic research on these reservoirs has provided a large, and growing, fraction of our understanding of tropical freshwater ecosystems. *Lake Kariba*, a summary statement by two scientists who were deeply involved with the first Zambezi River impoundment, is an important contribution to this understanding. The work really is two books in one, a limnological monograph by Coche and an ichthyological anthology coordinated by Balon. Together, they cover virtually everything that was known about Lake Kariba through 1972. With 300 tables of data and derivatives, they are almost opaquely technical, but readers who wish to debate any conclusions will do so from a solid base of information.

Coche's approach is the more encyclopedic. He has summarized the literature on the geomorphology and hydrology of the Zambezi basin above the dam, and from his own measurements he has computed nearly every conceivable limnological index—some classical, some new—for Lake Kariba. Most of his data on light penetration, temperature and oxygen distributions, and water chemistry derive from rapid lakewide surveys; although he has devoted some attention to subbasins, his analyses are essentially synoptic. Coche followed the evolution of the lake to its present state of hydrological stability, and the gross limnology of Lake Kariba now is substantially known.

Balon's approach is the antithesis of Coche's. Believing that the overall standing crops and production of fish could be deduced from intensive work at a few localities, Balon concentrated on obtaining nearly complete fish samples by blocking and poisoning small coves along the islands and mainland. Together with several colleagues, he has calculated standing crop estimates for most of the 40 species in the lake and production estimates for 17 of them. His extrapolations of the data to the whole lake are tenuous, but the data themselves are among the best of their kind anywhere.

The two sections of this book do not mesh at many points. Part of the reason is scale; the regional limnology subdues local nuances, while the restricted fish samples are dominated by them. The rest of the reason is ignorance; no one knows enough about the primary productivity, zooplankton, benthos, or trophic dynamics in Lake Kariba to attempt a convincing hydrobiological synthesis.

Lake Kariba is surprisingly similar to analogous temperate zone ecosystems. The same sampling methods can be applied there as in cooler climes and similar inferences drawn. Kariba's gross limnology seems familiar. Its fish production rates are higher than those in temperate lakes, but its standing fish biomass is not greater. Its fish species survived the transition from riverine to lacustrine conditions better than conventional wisdom about tropical species might have predicted, and some of them exploited new habitats as opportunistically as any temperate analog.

Lake Kariba is not parochial, either.

ROBERT L. KENDALL
American Fisheries Society, Washington, D.C.