field in Patagonia earlier in this century; he wears a gaucho outfit, including *bombachas*, *alpargatas*, and *faja*." Only a paleontologist who had himself intensively explored all aspects of South American mammal history could have written so rich and compelling a biography of his fellow explorers.

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Evolution in Slow Motion

Living Fossils. NILES ELDREDGE and STEVEN M. STANLEY, Eds. Springer-Verlag, New York, 1984. xii, 291 pp., illus. $45. Casebooks in Earth Sciences.

This volume, one of a series of casebooks in earth science, is more biological than geological, with an emphasis on "living." The editors' introduction is followed by 32 case histories, written by 31 authors, and two brief terminal essays by the editors. The goal is to provide enough case histories to enable an interested individual to decide if there is anything to the supposed phenomenon of arrested evolution.

What is a living fossil? To me the term relates to relicts, phylogenetically isolated groups with few living representatives, which closely resemble groups known only as fossils. When I checked Webster's unabridged dictionary I discovered that I was close to the apparently accepted definition. The unexpected (to me) criterion of the editors is that a living species must bear great anatomical similarity (bordering on identity) to a fossil species that occurs very early in the history of the lineage. One expects to find case histories of such forms as horseshoe crabs, coelacanths, *Peripatus*, *Nautilus* (all present), *Sphenodon*, and *Lingula* (both absent). But this book abounds in potential living fossils, from elephant shrews to odd corals, and the criteria for choice of subjects admit even such surprises as tree squirrels (*Sciurus*). Regrettably all plants are excluded. Of course, most of the authors devote considerable attention to the question of whether their particular organism is a living fossil.

A major theme is the issue of whether bradytely (very sluggish evolution) requires special explanation or is just the extreme tail of a normal distribution of evolutionary rates. A second theme is the relation of speciation to morphological change. Since speciation in the fossil record *is* morphological change, many arguments, especially by the editors, are confounded by the failure to separate these concepts properly.

Though many of the chapters are fairly straightforward and factual, a few stand out as contributions to evolutionary theory. Elisabeth Vrba's thoughtful contrast of the impala (the living fossil) and its sister group (blesbock-hartebeest-wildebeest group) is a good example. She places organisms in environments and takes into account factors (such as selection pressures) shunned by those with more taxic approaches, yet considers species-level implications (her "effect hypothesis") without giving species emergent properties. Peter Ward presents an exceptionally interesting analysis of *Nautilus* and argues that living nautiloids might be a rapidly speciating group constrained in its morphology by the need for effective swimming and maintenance of a buoyancy control system. The resulting morphological stasis masks evolutionary dynamism. Many living groups may have narrow bounds on the range of morphological divergence permitted, determined by organismal-level features, and they evolve as "living fossils" even though they may be speciose (as in the case of various urodele genera).

There are other good chapters (for example, Daniel Fisher's on horseshoe crabs), but most deal with cold facts outside a broad biological framework. Some make too much out of too little. Still, the book as a whole is a success—a rich source of information, references, and, occasionally, stimulation.

At the crux of the question of why we have living fossils is the debate concerning taxic and adaptive approaches in macroevolutionary theory. My impression is that in the data chapters only Vrba and Ward really address the issue and that only Ward grapples with the species question. We still are far from knowing whether slow evolution, even approximating stasis, results from slow rates of speciation (either because morphological change is concentrated in speciation events or because it is an incidental effect of speciation), from organismal-level systems of developmental and functional constraints that transcend speciation events, or from some combination of these and other factors.

T. J. M. Schopf, whose untimely death we mourn, questioned the entire notion of living fossils and thought that we focus too much attention on the persistence of traits that interest us. He had a point. Morphological evolution is very important for some groups and occurs rapidly. Other organisms live in worlds dominated by sensory modalities, for example, odors or other chemical cues, that do not require morphological change for persistence. The fossil record preserves morphologies. Morphology alerts us to the existence of evolution and demands explanation for its diversity. But our explanations must be based on realistic species concepts and assessment of the biological context in which evolution takes place.

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Environmental Physiology

Biochemical Adaptation. PETER W. HOCHACHKA and GEORGE N. SOMERO. Princeton University Press, Princeton, N.J., 1984. xx, 538 pp., illus. $60; paper, $19.50.

Hochachka and Somero's *Strategies of Biochemical Adaptation*, published in 1973, was an effort to bridge the interests of biochemists, physiologists, evolutionists, ecologists, and population biologists. The book was an overwhelming success. It was particularly useful for students confused by the more encyclopedic approach of many comparative physiology textbooks.

Biochemical Adaptation is a dramatic updating and expansion of the 1973 work. The authors have augmented its virtues, corrected many of its weaknesses, and pointed toward research horizons that were previously unapproachable. The central concern of the book is to elaborate the basic adaptive mechanisms employed by organisms living in diverse environments and to identify common biochemical strategies of adaptation. The authors have not attempted to cover every type of environment or mode of adaptation. Rather, they have focused on specific research topics or environmental parameters with respect to which some general statements can be made, conclusions drawn, or questions posed.

The book relies heavily on research from a limited repertoire of organisms, with particular emphasis on fish, mammals, and a few invertebrates. The selectivity of species and research topics does not diminish the value of the book. The examples are appropriate and accomplish the goals delineated in the preface. The authors' contagious enthusiasm and the clarity of their writing make this book an excellent teaching tool. For courses with an evolutionary emphasis,