Book Reviews

A Chronicle of Paleontology

Discoverers of the Lost World. An Account of Some of Those Who Brought Back to Life South American Mammals Long Buried in the Abyss of Time. GEORGE GAYLORD SIMPSON. Yale University Press, New Haven, Conn., 1984. viii, 223 pp. + plates. $25.

Having reviewed the evolutionary history of South American mammals in his 1980 book, *Splendid Isolation*, George Simpson, who died in early October, turned to the people behind the compiling of that history. The lives of these discoverers span nearly two centuries, and among them are roughly equal numbers of Europeans, North Americans, and native South Americans. The pervasive themes of Simpson's richly detailed and well-illustrated chronicle are the arduous quest for and the thrilling discovery of the strange extinct beasts of this remote and harsh yet beautiful continent. The latter half of the book is immeasurably enriched by the author's personal acquaintance with the principal figures and his deep involvement with the scientific endeavors during most of this century.

One of the important themes running through the book is the international collaborative nature of this paleontological enterprise. The major South American fossil collections are distributed widely over three continents, and major scientific papers on the fossils have appeared in at least seven languages. Florentino Ameghino, the most prolific of the main discoverers treated in this book, paid lasting tribute to his colleagues on three continents with his unique construction of patronyms for new genera, such as *Thomashuxleya* and *Henricosbornia*. On the other hand, Ameghino is also shown to have harbored a bitter rivalry toward his countryman H. Moreno and toward some others. Moreno himself suffered one of the most nefarious tricks in the checkered history of paleontology at the hands of another of his countrymen: as he was preparing a thorough description of a remarkable new Miocene beast, it was seen and quickly named by Hermann Burmeister so will forever be known as *Astrapotherium* Burmeister. Some of the most famous fossil deposits, such as the Pampean Pleistocene and the Santacrucian Miocene, were repeatedly worked by successive expeditions from various countries or even from rival institutions in the same country. Yet one gains the impression from these pages that such redundancy and competition had the healthy effects of adding depth to the completeness of the fossil samples and diversity to the scientific interpretations.

One of the patterns that I would not have expected that here clearly emerges is the extensive (though not complete) division of labor between the paleontologists who collected fossils and those who described them. Throughout this history they march in symbiotic pairs: Alexander von Humboldt and Georges Cuvier (who according to Simpson consistently misspelled Humboldt's name "Humbold"); Charles Darwin and Richard Owen (who later differed bitterly on evolution); Peter Lund and Herluf Winge (who never met, though both were native Danes); André Tournouër and Albert Gaudry; J. B. Hatcher and W. B. Scott (who received an important medal for exploring Patagonia, though he never got there); Elmer Riggs and Bryan Patterson; Llewelyn Price and Carlos de Paula Couto.

Another pattern well exhibited in this book, and presumably shared with most scientific disciplines, is the halting, crabwise progress of the central body of scientific understanding (paradigm) of the history of mammals in South America. From our present well-wrought orthodoxy it is astonishing to realize how recently our intellectual forebears labored in ignorance. Yet if we are to learn the lessons of history that is not the efficacious conclusion; rather, we in turn seem instructed to learn humility and to expect new pieces of the cumulative puzzle to arrive fortuitously and from unexpected quarters. Simpson himself labors most heavily with such questions in his extended analysis of Florentino Ameghino's intellectual balance sheet. For example, Ameghino first clearly conceived of and correctly set forth the full Tertiary stratigraphic succession in Argentina, contrary to several of his North American detractors; yet he also grossly overestimated the ages of those strata, and this led to (or did it follow from?) his greatest and most pervasive error, for which we remember him best, quite unfairly and in a manner reminiscent of our treatment of Lamarck. Having recognized fully, and for the first time, the unique nature of the whole Tertiary mammal fauna of Argentina, Ameghino interpreted it as representing a kind of Garden of Eden, with phylogenetic lineages leading off to all of the great orders of mammals throughout the rest of the world. One of the great ironies of this history is that, at almost the same time, Ameghino's good friend Albert Gaudry was correctly recognizing that the South American mammal fauna had evolved in isolation from the rest of the world's fauna and that any resemblances, such as the large size and trunk of *Pyrotherium* to similar features in elephants, were convergently developed. Ameghino and Gaudry both died before they could discuss their fundamentally different views of the record they had studied in concert.

And, of course, from time to time there are frauds that divert the attention of able scientists. Twice in this particular span of history New World scientists devoted their best didactic skills to tracking down live ground sloths in ways that now look foolish. Thomas Jefferson was closely associated with such a quest in North America, and perhaps among the results of the Lewis and Clark expedition should be recorded their important negative findings with respect to living *Megalonyx*. More impressive at the turn of this century was the immense flurry of papers, including that in which Gaudry named the living mylodont sloth *Neomylodon listai*, in honor of the man who "found" it in Chile. Had it really been found Gaudry would have beaten his rivals to press.

Through the mass of bibliographic information that Simpson has ferreted out, and through the foibles and failures of some extraordinary men (no women played lead roles in this drama), the body of knowledge of South American mammal history slowly increases. One of the greatest epiphanies occurs when Carlos Ameghino realizes that much of the Tertiary history of his continent is stacked in multiple fossiliferous layers in the Gran Barranca of Patagonia. "Even in a personal retrospect of 60 years, a paleontologist feels the elation of young Carlos with . . . this discovery." Simpson thus includes his own involvement with the whole historical enterprise that he so meticulously documents here. Simpson also appears on the front cover of this book, although the picture is somewhat coyly labeled "A paleontologist in the

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,