BOOK REVIEW


It used to be common knowledge that researchers, approaching the ends of their careers, would attempt a grand synthesis of what they had thought and learned. These met with varying degrees of success, often ranging from re-stating the obvious, to, as Ambrose Bierce (1911) wrote of St. John the Divine, the author “concealing all that he knew,” and leaving the revelation to the reader, who, presumably, knew rather less. Neither is the case here. This work is an approach to discerning the general properties of the evolution, particularly macroevolution, of life on Earth. The emphasis is on animals, although plants and microorganisms are by no means ignored. A secondary concern is the application of these general principles to expectations regarding extraterrestrial life. This book is not for beginners, but professionals, graduate students, advanced undergraduates, and logically literate amateurs—even philosophers of science and science fiction authors (I’m not always convinced these are separate categories)—will find it enlightening and stimulating. Certainly some will find much to disagree with, but others much to agree with.

The bulk of the text—Chapters 2 through 14, of 15—presents a history of the Earth, emphasizing the history of life, in chronological order from its condensation in the preplanetary Solar nebula to the present day. These are preceded by the preface and first chapter that ‘set the scene’ both in a personal sense (in the preface) and from a more general philosophical framework (in Chapter 1). The book concludes with a summary of the major features of evolution as Russell sees them, and their philosophical implications. The chapters are clear, concise, and well written, usually with a list of significant events of the time covered. I had intended to read one per day, but as in the old potato chip commercial, I found it impossible to stop after just one. The writing successfully evokes visualizations of the Earth’s surface for each time considered. Additionally, the work is well illustrated, by a series of color photographs of modern scenes chosen to evoke how the world in the past may have appeared, as well as line drawings reconstructing particular time periods, and drawings, graphs, and photos to illustrate specific points.

The text presents a narrative of events, without critical analysis of the evidence for them, although I suspect that such analyses would have more than doubled the length of a work that already approaches the comfortable limit of size. I am not certain that all of the events are equally well supported, but the extensive citations make it easy for the reader to refer to the primary and secondary literature. Indeed, its extensive bibliography (78 pages) covering a wide range of relevant issues is a commendably useful feature of the book, one that will doubtless be much appreciated by those teaching historical geology or paleontology.

The overarching theme is that, contrary to some views, there is a discernable trajectory to macroevolution on Earth and discernible trends in the evolution of, particularly, vertebrates. This is reasonably obvious to many, but hasn’t been popular among some philosophically inclined evolutionary biologists. Russell proposes an idiosyncratic—but conceptually useful and significant—new usage of ‘adaptation’ and ‘fitness’ to distinguish between selective modifications due to physical or biotic environments. He examines particular anatomical, metabolic, and behavioral features that influenced these trends. More specific features of macroevolution are also treated, especially toward the end of the first chapter. One ‘subplot’ is to examine under what conditions relictual forms—that is, clades relatively unchanged, and hence stable, over long periods of time—persist.

A few of the points occurring to me include wondering, in the gedankenexperiment of comparing the fitnesses of modern and Devonian organisms in Chapter 1, whether or not Devonian microorganisms might be pathogenic in modern organisms. Russell, unlike some others, uses the gedankenexperiment appropriately to clarify the implications of his hypothesis (Hesse, 1962), not to attempt to discern facts. Do social interactions actually create individual intelligence, or do social organizations obviate the importance of individual intelligence by virtue of social division of labor? I suspect that microbes might have been given somewhat of a short shift by neglecting their unusual (for eukaryotes) genetic mechanisms described by Caporale (2006) and Sonea and Panisset (1983) that may result in different modalities of fitness and adaptation.

Russell’s treatment is at a fairly abstract level. He doesn’t examine specific taxa (i.e., genera and species) but presents overall trends at higher taxonomic levels. Sometimes ‘natural experiments’ have been provided by continental drift. Toward the end of Chapter 13 he compares the dinosaurian faunas of Alberta and the Southern Hemisphere (as well as presenting an enlightening comparison of Jurassic and Cretaceous dinosaurian faunas in North America). Some taxa (at least three hadrosaurs and a ceratopsian) typical of Alberta moved into South America near the end of the Cretaceous, probably in the Campanian. The scarcity of their fossils suggests that they lacked substantially greater fitness (in Russell’s sense) than the endemic sauropods and ornithopods. This leads me to wonder if, given the incompleteness of the fossil record, observation of fossils alone is adequate to determine relative fitness in specific instances. But what else are we to do, and I must admit to being sympathetic to Russell’s endeavours and the contention that over the whole span of life on Earth fitness has generally increased. A fundamental problem is how to learn why some clades are capable of evolving successful adaptations (in the ‘pre-Russellian’ sense) and others are not. Given the commonality of convergence, at least among animals, the question of why some clades are able to develop convergent structures and behaviors, whereas others do not, seems worthy of attention. Approaches to an answer were suggested by the talks of F. Galis and E. Buchholtz at the 2009 joint meetings of the SVP and SVPCA. The network of genetic interactions in early development may create constraints on what features can or cannot be evolved (see also Kopp, 2009). To give a technological analogy, changing in the face of these constraints would be like retooling a factory that produces cell phones to make rocket motors. Thus in addition to physical and biotic environmental selections, there may be an internal influence on evolution, although not in the old sense of orthogenesis or entelechy. This suggests that there may be more to determining the adaptation or fitness of a clade than environmental influences. If Buchholtz (2009) and Galis (2009) are on the right track regarding developmental constraints of the neck in therian mammals, maybe regardless of environmental factors it is simply not possible for therians to occupy the niches of elasmosaurs or long-necked sauropods. And thus,