

## Revue des livres

## Book Review

**GORDON, M. S. & E. C. OLSON, 1995. *Invasions of the Land*. Columbia University Press, New York, xv + 312 p., 16 × 23.5 cm, hard cover US\$70.00, ISBN 0-231-06876-X.**

In 1990, while summarizing the inadequacies of the fossil record for addressing the origin of life on land, Colin Little admitted that: "On the other hand, of course, fossil evidence provides the only direct picture of past communities, and, as long as its shortcomings are recognized, it provides an invaluable tool" (Little, 1990: 37). It is in this spirit that Gordon and Olson's volume fills a major void in understanding the colonization of land by organisms of all trophic classes, presumably during the mid-Ordovician to Early Devonian from 450 to 400 million years ago. Theirs is the first book-length effort to seriously incorporate both the direct record of the fossils and rocks and the biologies of modern descendants in discussing one of the most phenomenal events in the history of life. This event, the terrestrialization of several major lineages of marine organisms, included vascular plants, chelicerate, crustacean and hexapodan arthropods, and vertebrates, and currently represents the known centers of macroscopic biodiversity on the planet.

*Invasions of the Land* is organized into ten chapters. The first two are prefatory; chapter 1 discusses definitions, concepts, assumptions, and previous studies, while chapter 2 provides an overview of the mid-Paleozoic physical environment. The body of the book, chapters 3 to 9, concerns the nature of the fossil evidence and aspects of the physiology of modern descendants that appropriately bear on the colonization of land. These chapters emphasize green plants, specifically green algae, bryophytes and vascular plants; molluscan, annelid and crustacean invertebrates; and vertebrates. Chapter 10 offers a synthesis by summarizing conclusions and providing suggestions for further work. Given the immense scope of the topic, review and discussion of the relevant literature is necessarily condensed and often generalized, though important points are mentioned that describe how various marine groups have uniquely adapted to an inhospitable environment on land. The intellectual tack the authors use in these characterizations is strictly adaptationist, as they freely admit, and thus they leave little flexibility for considering alternative sources that may have channeled particular trajectories toward life on land. One of these deficiencies is lack of significant discussion of constructional constraints in marine forerunners, which would have benefited from some cladistic insights as to which synapomorphies contributed to particular modes of terrestrialization in particular but major subclades within the mollusc, annelid, arthropod, and vertebrate lineages.

Specific attributes of major clades of organisms that relate to their terrestrial existence can be analyzed, often in revealing ways, by reference to physiological, biomechanical, structural, and ecologic approaches that do not necessarily encompass a phylogenetic framework. However, when histories of these same clades are discussed, there is a compelling reason to phenomenologically anchor them as historical entities defined by a specific set of synapomorphies. Otherwise, it becomes unclear as to whether the summaries of particular "groups" of organisms have evolved by parallelisms, convergences, iterative reinventions, or simply as imprecise definitions of the "groups" themselves. The distribution of these attributes and the pattern that they reveal can be ascertained for at least the major subclades of terrestrialized lineages for which there is considerable recent effort, including vascular plants, hexapod and crustacean arthropods, and vertebrates. The authors had an opportunity to examine explicitly the phylogeny of terrestriality and to explicitly compare how the biologies of land lineages achieved the same ends with undoubtedly different means.

As one that is concerned about the fossil record of land arthropods, I was troubled by two, probably minor, aspects of the book: use of the anachronistic term "Uniramia," and avoidance of any substantive discussion of the most notorious terrestrialized clade of them all—the insects. For some time now it has become clear that the term "Uniramia" no longer refers to a clade recognized by most arthropodologists. Although the designation Uniramia was coined by Manton based on functional-morphological grounds, its subsequent appropriation by phylogeneticists to describe a lineage of arthropods ran into major pitfalls when cladistic analyses of the Arthropoda revealed that arthropods are probably monophyletic and onychophorans are not related to myriapods or hexapods (see also Kukalová-Peck, 1992). Furthermore, recent work during the past five years suggests that hexapods may not be related to myriapods, and may be a sister-group to or a derived group within the Crustacea (Turbeville *et al.*, 1991; Osorio & Bacon, 1994). For the insects, discussion of their likely route to terrestrialization would emphasize studies on modern primitive forms, since only scraps of material have been found from Early and Middle Devonian deposits. A sizable body of literature exists on the physiology of archaeognathan, thysanuran and primitive winged insects which would have warranted discussion.

On the positive side, I applaud the authors in placing a functional uniformitarian umbrella on a mid-Paleozoic landscape, and avoiding the temptation toward looking at modern taxa and ecosystems for insight. It is well known that the further one proceeds back in time, the less likely that modern ecologic conditions prevailed. This is particularly true for taxonomic- and ecosystem-based versions of uniformitarianism. The authors rightfully assert that the sparse fossil record of mid-Paleozoic land organisms should be interpreted by biochemical, functional morphological, biomechanical, and physiological principles common to well documented, specific clades.

On balance, I highly recommend this book as a primer for neobiologists and paleobiologists interested in how life moved onto land. While I have dwelled on a few peccadillos, this volume has an integrative sweep, a scholarly context, and a unique status as the only comprehensive book in the field. I suspect that it will remain as an ancillary text for courses in paleobiology and evolutionary biology for some time. The authors are to be commended for taking Little's (1990) covert challenge to task.

#### Literature cited

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