BOOK REVIEWS

Vertebrates Ashore

Amniote Origins. Completing the Transition to Land. STUART S. SUMIDA and KAREN L. M. MARTIN, Eds. Academic Press, San Diego, CA 1996. x, 510 pp., illus. $74.95 or £55. ISBN 0-12-676460-3.

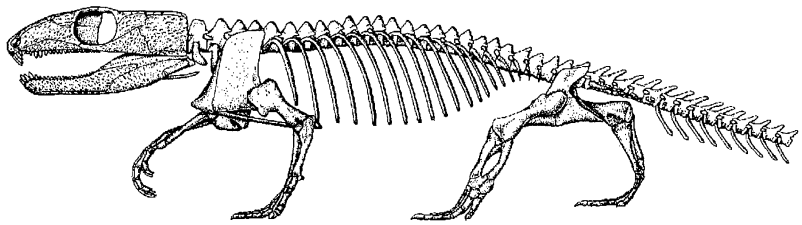
Until recently, there has been no concerted effort to evaluate and synthesize the myriad of paleontological and neontological data bearing on the origin of the amniote egg, or indeed, of the Amniotes—the group comprising the reptiles, birds, and mammals—themselves. This volume attempts to fill the void.

The earliest tetrapods, the crocodile-like labyrinthodont amphibians, probably evolved from large, "fleshy-finned" (crossopterygian) bony fish during the mid-Paleozoic era, about 375 to 400 million years ago. Thereafter, one of the most important evolutionary rubicons in the radiation of terrestrial vertebrates was the development of the amniotic egg. With its protective shell and extensive extraembryonic membranes, the amniotic egg greatly facilitated reproduction in non-aqueous environments and effectively opened vast regions of both mesic and xeric terrestrial environments to vertebrate colonization.

At the volume's outset, Laurin and Reisz present a novel cladistic analysis in which lepospondyl amphibians (including a variety of mostly salamander-like Paleozoic forms, as well as living salamanders and frogs) are interpreted as being much more closely related to the earliest amniotes than assumed previously. However, many of Laurin and Reisz's most significant nodes lack solid objective support (see R. L. Carroll, *Bull. Mus. Hist. Nat. Paris* 4ème sér., **17**, 389–445 [1995]). In addition, many of the character transformations used to support lepospondyl-amniote affinity were either frequently achieved in other clades, were subject to common reversal, or are anatomically improbable (for example, a major reduction in number of presacral vertebrae and re-elaboration of the proatlas in three separate lineages).

Laurin and Reisz's use of cladograms is also instrumental in their rejection of Carroll's widely accepted hypothesis that early amniotes were small and oviparous. However, the earliest known ancestors of amniotes were, in fact, small (~100-mm-snout-to-vent length), and the fossil record of early amniotes clearly documents progressive size increase.

Carroll's model of protoamniotes is accepted in later chapters in this volume by Packard and Seymour and by Stewart. In the course of comprehensive reviews of a variety of amphibian/amniote developmental features, these authors point out that the early development of a small, shelled egg deposited on land would have been necessary to facilitate diffusion of oxygen to the developing embryo as well as to provide mechanical support. Additionally, Stewart points out that recent embryological studies conclude that the probable excretory function of the primitive allantois, an extraembryonic membrane synapomorphous for amniotes, is also consistent with ovipary in protoamniotes.



Reconstruction of *Eocaptorhinus laticeps*, a Late Paleozoic amniote. Length, about 30 centimeters. [From Sumida's paper in *Amniote Origins*; after Heaton and Reisz, 1980]

Several chapters deal, at least indirectly, with alterations in the skin that probably accompanied the development of complete terrestrialism in amniotes. In an especially informative chapter, Frolich reviews osmoregulatory and mechanical properties of tetrapod skin. Interestingly, he concludes that the major adaptive feature of amniote skin was reduction of the dermis and elaboration of a low-mass epidermis, largely for resistance to mechanical abrasion rather than for waterproofing. Curiously, in another chapter Martin and Nagy suggest that epidermal waterproofing and an extensive dermal armor for resistance to mechanical abrasion were major attributes of the skin in early amniotes.

Two chapters are devoted to physical aspects of the Paleozoic world. A careful compilation of Mid- to Late Paleozoic biogeography is provided by Berman, Sumida, and Lombard. Given the close proximity of Late Paleozoic landmasses, the apparent cosmopolitan or near cosmopolitan distribution of many taxa is not unexpected. However, the authors themselves point out that the paucity of fossil deposits dating from this period poses a severe limitation to more detailed conclusions about factors facilitating and limiting distribution of virtually all Late Paleozoic taxa.

Graham, Aguilar, Dudley, and Gans review evidence that, compared to today's atmosphere, the Late Paleozoic Era atmosphere contained higher concentrations of oxygen but lower levels of carbon dioxide. Unfortunately, the authors fall prey to the common misconception that higher levels of atmospheric oxygen content somehow signify that Paleozoic vertebrates maintained higher levels of activity than would be possible today. This is unfounded: at the current "low" levels of atmospheric oxygen, all extant tetrapods maintain fully saturated levels of arterial oxyhemoglobin, and even significant increases in aerial oxygen content would have little effect on blood oxygen carrying capacity.

The book also includes several chapters on early tetrapod locomotion, herbivory, and trophic apparatus. Unfortunately, it lacks a concluding synthesis or overview, and the reader is left with little, if any, direction for resolution of the conflicting hypotheses set forth in the text. Nevertheless, *Amniote Origins* provides a useful, if uneven, foundation for future biologically oriented investigations of the origin of amniotes.

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Nerve Cells with Names

The Neurobiology of an Insect Brain. MALCOLM BURROWS. Oxford University Press, New York, 1996. xvi, 682 pp., illus. $100 or £55. ISBN 0-19-852344-0.

The devastation of native crops by locust plagues was a major problem in the governance of the British Empire, and the Anti-Locust Research Center was established in Britain to make these animals available for study to control their spread. The diverse