Triassic Life on Land: The Great Transition

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DAWN OF THE AGE OF DINOSAURS AND OUR MODERN BIOTA

Triassic Life on Land: The Great Transition. Hans-Dieter Sues and Nicholas C. Fraser. Columbia University Press, 2010. 224 pp., illus. $39.00 (ISBN 9780231135221 cloth).

The Triassic period (252 million to 201 million years ago) is one of the most significant eras in the history of terrestrial life. Its beginnings stem from the biotic wreckage following the largest extinction event ever (the end-Permian extinction, 252 million years ago), as surviving groups reestablished themselves. These survivors were remnants of an archaic biota dominated by basal synapsids (stem-mammals) and labyrinthodont amphibians, as well as lycopods and pteridosperms (seed ferns). Also present was a group of reptiles known as the archosaurs, whose modern representatives include crocodilians and birds. Archosaurs first appeared shortly before the end-Permian extinction and diversified throughout the Triassic period in two lineages—the pseudosuchians (the crocodilian lineage) and the ornithodirans (the bird lineage). The most significant group of ornithodirans was a group known as the dinosaurs.

The Triassic is the only time period bracketed by major extinction events. By its end, however, conditions were in place for the foundation of Earth's extant biota. Although these lineages were decimated to some degree, they survived the end-Triassic extinction, including dinosaurs (birds), crocodilians, stem-mammals, lepidosaurs, turtles, water bugs, and flies. Thus, as is often stated, the Triassic is the "dawn of our modern ecosystem." The paleontology and geology of the Triassic period are currently prominent research topics, and this resurgence of interest is the basis for the book *Triassic Life on Land: The Great Transition,* which is essentially an overview of the history of Triassic terrestrial life. Authors Hans-Dieter Sues and Nicholas Fraser are authorities on this time period; they share a combined history of more than 60 years of research.

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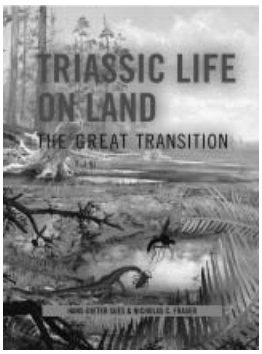

Triassic Life on Land is a technical treatise, differing from the more general recent text on the Triassic, *Dawn of the Dinosaurs: Life in the Triassic* (Fraser 2006). Accordingly, it is more likely to be useful for advanced students and researchers. The book comprises 11 chapters arranged mainly by time and geography. The introduction provides background on the Triassic timescale and details on stratigraphy, biostratigraphy, and magnetostratigraphy. The introduction also covers Triassic paleogeography and concludes with a brief overview of the phylogeny of major tetrapod groups found in the Triassic.

Triassic vertebrate paleontology is experiencing a renaissance after decades of being overshadowed by discoveries from the latter portion of the Mesozoic era, particularly those useful for elucidating the later evolution and subsequent extinction of the nonavian dinosaurs. Researchers once hypothesized that although the Triassic was the period in which dinosaurs originated and had their early evolution, the lower diversity of dinosaurian taxa during this time precludes any meaningful study of the mode and tempo of dinosaur evolution or of their biogeographic distribution patterns in the late Mesozoic. This is mainly because of the rarity of Triassic dinosaur fossils and because character distributions that diagnose dinosaurian taxa have often been inadequately understood. Likewise, Pseudosuchia has suffered from a lack of understanding of in-group diversity and character distributions. Prior to the 1990s, book chapters on the Triassic were generally restricted in their coverage to early Mesozoic archosaurs, simply stating that the Triassic—especially in the latter portion of the period, in what is now North America—was essentially the time of "thecodonts" and the early dinosaur *Coelophysis*.

The advent of phylogenetic analysis, or cladistics, which could be used to determine testable relationships within Archosauria, in the mid-1980s provided a sorely needed means for clarification within this group. Finally, there was conclusive evidence as to what exactly a dinosaur was. This paradigm shift, in conjunction with new studies on Triassic archosaur taxonomy, set the stage for a renaissance in Triassic paleontology, which has continued to the present.

During the Triassic period, the major global landmass was the supercontinent Pangaea, subdivided into the northern area of Laurasia and the southern Gondwana. Throughout seven chapters, Sues and Fraser detail the Gondwanan and Laurasian biotas during the three Triassic epochs and include figures depicting many of the featured organisms. It is quickly apparent in these sections that despite the presence of only a single continent, much endemism of biotic elements still existed. Rather than seeing a cosmopolitan global biota as was previously hypothesized (e.g., Colbert 1971), current researchers see restricted and differing biotas, perhaps pertaining to latitudinal differences in climate. This endemism is a major barrier to attempts to construct a global biostratigraphy of the Triassic (e.g., Lucas 1998, 2010), and comments by Sues and Fraser imply that they are still lukewarm to this concept. The amount of discussion that is provided for each geographical area and time bin reflects the authors' current knowledge of the biotas in those provinces. Less coverage

is often a result of poor geologic exposure rather than of a lack of work. Consequently, well-studied areas and time bins are better discussed, such as the Karoo Basin in South Africa and the Germanic Basin and the Late Triassic period sites in the western United States. Other locations, such as the Late Triassic sites in Great Britain and the eastern United States, also receive greater coverage because they are the areas in which the authors conduct research. The latter area is especially important, because fossil finds are correlable with a global standard for magnetostatigraphy and its associated astronomically tuned timescale.

Chapter nine provides a detailed look into two specific localities. The Madygen (Kyrgyzstan) and the Solite Quarry (Virginia) provide unique glimpses into Late Triassic time, because they preserve a variety of fossils of plants and animals; however, they are especially extraordinary for their preservation of soft body parts, including those of insects. The book closes with chapters on biotic changes through the Triassic and the end-Triassic extinction event, which was one of the "big five" extinction events in Earth history. This extinction saw the end of many archosaurian lineages—most notably, a majority of the pseudosuchians—and gave way for the subsequent rise of the dinosaurs over the next 180 million years. Sues and Fraser discuss the various extinction hypotheses, including climate change, mass volcanism, and even bolide impacts, but are not able to conclusively side with any of these causes.

Triassic Life on Land thoroughly examines the current state of understanding regarding terrestrial ecosystems of the Triassic period. Although it is focused on vertebrate remains, the book also includes many in-depth sections on the plants and insects of the time, making this an extremely well-rounded reference. Furthermore, the book details many prominent topics currently debated by researchers, including the timing of recovery from the end-Permian extinction, the early appearance and evolution of the dinosaurs, and the mode and timing of the end-Triassic extinction. *Triassic Life on Land* is well written and well edited, with many excellent figures. The content is mostly up to date, containing references as recent as 2009. As with any book on a subject that is the focus of much current research, there is already some out-of-date material; however, the amount of this material is minimal. In summary, *Triassic Life on Land* is the best technical reference available on the Triassic period and brings us forward from the days of "thecodonts" and *Coelophysis*.

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