

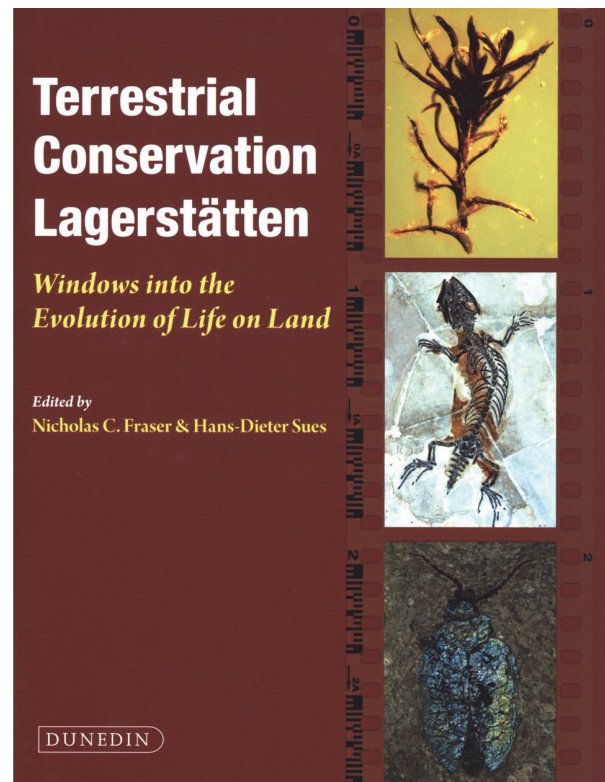
Terrestrial Conservation Lagerstätten: Windows in the evolution of Life on Land

Review by Alexander K. Hastings

Terrestrial Conservation Lagerstätten: Windows into the Evolution of Life on Land. 2017. Fraser N.C. and Sues H.-D. (eds). Dunedin Academic Press. £165.00. 450 pages.

The German term *Konservat-Lagerstätten* is applied to those fossil sites that exhibit truly exceptional preservation. These sites contain fossils with amazingly detailed anatomy that can only be preserved under special circumstances, usually including soft tissues like hair and feathers. The new book *Terrestrial Conservation Lagerstätten*, edited by Drs. Nicholas Fraser and Hans-Dieter Sues, highlights nine such fossil sites from terrestrial ecosystems around the world. The editors have assembled a cast of Lagerstätten covering a huge swath of life, ranging from the Paleozoic to the Cenozoic and including localities in Europe, Asia, North America and South America. Each chapter is devoted to a different Lagerstätte, which are (with one exception) arranged in terms of geologic age, oldest to youngest.

After a brief introduction, the book dives into the first featured Lagerstätte, the Rhynie Chert. The Rhynie Chert and associated Windyfield Chert are early Devonian deposits (about 407 million years old) in Scotland where fossils are preserved within chert nodules. These nodules can be thin-sectioned to reveal minute details of the water-to-land transition in plants and animals. This site boasts the earliest preservation of the full life cycle of any land plant, where researchers have been able to isolate the entire reproductive history of *Aglaophyton*–*Lyonophyton*. In addition to discussion of paleobiology and paleoecology at the site,



this chapter gives particular attention to the geological processes behind how these fossils came to be preserved. The following chapter focuses on the early Carboniferous East Kirkton Lagerstätte, also in Scotland. Fossils from this site include large

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Hastings, Alexander K. 2018. [Review of *Terrestrial Conservation Lagerstätten: Windows in the evolution of Life on Land*, edited by Fraser N.C. and Sues H.-D.]. *Palaeontologia Electronica* Vol. 21, Issue 1; 2R:3p; palaeo-electronica.org/content/2018/2171-review-terrestrial

scorpions and eurypterids, but the premiere attraction is an array of stem tetrapods. Each of the seven recognized East Kirkton tetrapod taxa is described, including a comprehensive review of what material has been found and where they are thought to fit into the larger scheme of tetrapod evolution.

Jumping into the Mesozoic, the book highlights two Triassic sites, beginning with the Madygen Lagerstätte of Kyrgyzstan. Less well known than most of the other featured Lagerstätten, this chapter does a great job of recapping not only the fauna recovered there but also the sedimentary environments and different habitats likely preserved in the formation. The beautiful illustrations of various interpretations of the bizarre appendages on the back of the enigmatic reptile *Longisquama* are a particular highlight, and show how much paleobiological uncertainty can exist even for exceptionally-preserved fossils. Moving to North America but sticking with the Triassic, the following chapter delves into the incredibly abundant, well-preserved fossils at the Solite Quarry, located on the border between Virginia and North Carolina in the eastern United States. This chapter gives special attention to the insect fauna (one of the richest known from the Triassic) and discusses recent reinterpretation of the site as a shallow, marginal lake deposit rather than a deep-water basin as traditionally thought. The chapter also features very nice artistic reconstructions and discussion of the two best-known reptilian taxa from this site, the swimming *Tanytrachelos* and the gliding *Mecistotrachelos*.

The next two chapters move forward in the Mesozoic with a pair of Chinese Lagerstätten, beginning with the Yanliao Biota. This fossil assemblage dates to the middle-late Jurassic and includes a wide variety of plants and animals, including incredibly important specimens like the oldest eutherian mammal and the earliest feathered dinosaurs. The Early Cretaceous Jehol Biota, also from northeast China, likewise includes amazing preservation with taxa that are critical to our understanding of the evolution of major vertebrate groups. These include the four-winged *Microaptor* and feathered tyrannosaurids, in addition to trophic revelations such as a large mammal (*Repenomamus*) with a young dinosaur (*Psittacosaurus*) in its stomach. This chapter also features a very useful set of tables listing the extensive and at times taxonomically-byzantine biota. Continuing in the Early Cretaceous, the following chapter features the Santana Formation of northeastern Bra-

zil. This formation has become particularly known for its very well-preserved fishes within carbonate concretions. This chapter discusses these iconic fishes, but also provides an overview of the regional geology and distribution of the unit as well as the other kinds of fossil organisms recovered there. Among these others are exceedingly rare discoveries like a fossilized parasitic copepod (about 1 mm long) found on the gill of a fossil fish and three-dimensionally-preserved pterosaur skeletons.

The next chapter moves into the Cenozoic with the world-renowned Messel Pit. This Eocene Lagerstätte is located in western Germany, where thousands of fossils representing an entire ecosystem have been preserved in incredible detail in oil shales deposited in a paleolake. Messel boasts over 16,000 fossil insect specimens, turtles preserved in the act of mating, and numerous mammals showing skin and hair preservation, including an entire community of bats and the early primate *Darwinius*. Entire books have been written about the Messel Pit, so considering the immense breadth of scholarship on this site, the chapter does a good job of giving a broad overview with some interesting highlights. The final chapter returns to the Cretaceous, but gives an overview of organisms preserved in amber of all ages, with particular focus on arthropods. The core of this chapter is the amazing diversity found within Cretaceous Burmese amber. Amber permits three-dimensional preservation of very minuscule morphology otherwise unknown in the fossil record, and the authors describe the formation of these deposits and taxa of special importance. Some significant discoveries have been the preservation of eusociality in ants and termites and even two ants of different species fighting. However, it seems this chapter went to print before being able to include some of the most striking recent discoveries of vertebrates in amber, including a dinosaur tail and baby bird (Xing et al. 2016, 2017). The chapter also includes some very helpful appendices that summarize arthropod-bearing amber deposits across the world, through time. These are presented both according to location and according to taxa.

Overall, this book is a great overview of nine of the most impressive fossil sites in the world. Each chapter provides a bit of the history of fossil-collecting, the geology, and a run-down of the taxa identified at the site so far. The volume is loaded with big color photographs of gorgeously preserved specimens, making it a great book to peruse even

if only for the pictures. It also serves as a general reference for each of the sites, although has quite a bit of taxonomic jargon that may be cumbersome for those unfamiliar with each of the biotas concerned. There is also a fair bit of anatomical terminology that some readers may be less familiar with, e.g., those concerning plant reproduction or insect organs. These make it a difficult read for non-pale-

ontologists, but should be fine for the intended scientific audience. Even if the taxonomic group in question is out of your area, the chapters still provide useful information pointing you to delve in further if interested. I recommend this book for anyone particularly interested in taphonomy, evolution of life on land, and/or fantastic pictures of really exceptional fossils.

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