The Ever Enigmatic Ediacarans

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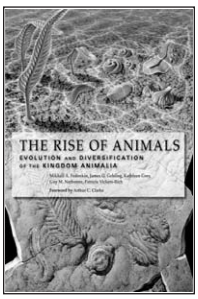
THE EVER ENIGMATIC EDIACARANS

The Rise of Animals: Evolution and Diversification of the Kingdom Animalia. Mikhail A. Fedonkin, James G. Gehling, Kathleen Grey, Guy M. Narbonne, and Patricia Vickers-Rich. Johns Hopkins University Press, 2008. 344 pp., illus. $75.00 (ISBN 9780801886799 cloth).

The fossils that are the subject of *The Rise of Animals: Evolution and Diversification of the Kingdom Animalia* are the so-called Ediacarans. They are variably identified as the ancestors of animals, as a wholly extinct experiment in animal relatives or an extinct kingdom of life, as giant unicellular organisms, as fungi, or as lichens. They are known from thousands of specimens (at some localities they cover huge bedding surfaces), span the world geographically, and existed for more than 30 million years. This time window is from about 575 million to 542 million years ago, after which undisputed animals erupt in the paleontological record, and apart from a couple of possible survivors in the Cambrian, the Ediacarans vanished.

Ediacarans are not inconspicuous creatures—some frondlike forms attained a length of two meters—and they often display a considerable degree of anatomical detail. These factors would seem to suggest that we should be able to place these organisms on the tree of life with some confidence, yet the diversity of opinion about what these fossils represent is wide. The who, what, where, when, and why of the Ediacarans is the subject matter of Fedonkin and colleagues' *Rise of Animals*.

The target audience is said to be "scientist and layperson alike," and the book certainly offers much to both groups. Its large format and extensive use of color give it the look of a coffee table book, richly illustrated with photographs of fossils, reconstructions of the organisms, and field photographs of Ediacarans in their geological context (and quite a few photos of the people who collect them, too). Peter Trusler's magnificent paintings of field sites of the classic Ediacaran localities contribute greatly to the book's visual appeal. The authors include leading researchers on Ediacaran fossils from three countries that are home to diverse, well-preserved, and historically important Ediacarans—Russia, Australia, and Canada—and much of the book is structured as a travelogue of journeys to these field sites.



Given that Ediacarans occur in remote parts of the White Sea and the northern Canadian Cordillera, the Flinders Ranges of South Australia, and the sea-sprayed cliffs of Newfoundland, there is an element of adventure to the descriptions of the discovery and collection of these creatures. The geological context of the major sites is depicted through color images of stratigraphic columns and maps, as well as models showing how these soft-bodied fossils came to be preserved. The human element of research is prominent—the reader sees and meets the people who have devoted their careers to puzzling over Ediacarans.

For professional paleontologists, a 32-page atlas of all formally named Ediacarans is an especially useful feature. Each species is listed alphabetically, with a photograph, occurrences, synonymous names, and a discussion on likely affinities and classification. The synonymies are especially useful because many Ediacarans that were once identified as complete organisms are now recognized as parts of other Ediacarans (e.g., what were once thought to be jellyfish fossils are now known to be the holdfasts of fronds), so one name applies to both parts of the creature, and some former Ediacarans are no longer even identified as fossils, but rather as abiogenic structures. The bibliography is likewise a godsend for those who are keen to collect literature on these fossils.

In addition to the core chapters on Ediacaran localities, the book is rounded out by (a) overviews on the history of Earth, from the Big Bang to the melting of glaciers, which formally marks the beginning of the Ediacaran period; (b) trace fossils produced by the Ediacarans and the less-controversial animals that lived alongside them; and (c) a review of animal body plans and the question of what caused the Cambrian radiation, a 15-million-year period in the Early Cambrian when animals with skeletons diversified. A stand-alone chapter on microfossils is less chatty than some of the others, but it is a solid scientific contribution that reminds the reader that not all fossils are macroscopic and much can be learned about ecosystems from such humble creatures as acritarchs.

To address the question of what the Ediacarans are, the authors accurately record the numerous alternatives for most of them, but in general the thesis of the book, as the title conveys, is that these fossils include the ancestors of animals. Ediacarans are often referred to as animals or metazoans, and the general message is that many of today's animal phyla were represented, at least by their stem groups, in the Ediacaran. On page 51, for example, arthropods, nematodes, molluscs, annelids, brachiopods, platyhelminths, chordates, and ctenophores are all said to be present in Ediacaran biota. The case for most of these is weak, and none is strong. A chordate, for example, is mentioned as a "possible chordate" in a figure caption, but the possibility that it could instead be a preservational variant of the mollusc-like *Kimberella* is raised as an alternative in the same caption. The case for platyhelminths is based on crude comparisons of *Platypholina* and rhabdocoel flatworms (p. 137), and much the same applies to alleged Ediacaran nematodes and brachiopods. Ediacaran specialists are notably more likely to assign Edi-

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acaran fossils to Annelida and Arthropoda than are those who work on those groups.

The picture of Ediacarans as ancestral animals means that in some respects the authors do not fully embrace the implications of the "new animal phylogeny." The relationships between animal phyla reconstructed from DNA sequences are depicted twice in the book, but in other places the grand narrative of animal evolution devolves into notions from a pre-1990s textbook. On page 45, animal evolution is described as a *scala naturae* from sponges to diploblasts to platyhelminths to coelomates. This narrative conflicts with the current view of animal phylogeny in that platyhelminths are now seen as nested within a clade of spiral-cleaving animals that also includes annelids and molluscs, and coelomates are not regarded as a monophyletic group. In some chapters, various Ediacarans are assigned to a group named Proarticulata, which made sense when it was established in the 1980s, but now that the Articulata (annelids and arthropods sharing a single origin of segmentation) has been rejected by molecular phylogenies, "Proarticulata" is ancestral to a nongroup. In these instances, fossils are getting shoehorned into an evolutionary framework that is past its use-by date.

Now and then, apparent disagreements between the authors seem to crop up. On page 137, *Dickinsonia* is stated to have the zigzag style of symmetry called glide refection, but on page 269, it is said to have mirror-image, bilateral symmetry. This difference is essential to understanding whether *Dickinsonia* is segmented in a way that has real bearing on affinities to extant segmented animals. The discrepancy gets at the heart of what is ultimately so frustrating and fascinating about the Ediacarans—the fact that two specialists can study myriad specimens for years, yet Ediacarans' basic construction remains controversial. That *Swartpuntia* from Namibia could be either "a colonial animal or even a large alga" (says coauthor Gehling) or "allied with the dickinsoniomorphs" (per coauthor Narbonne) indicates that we still have a long way to go in making evolutionary sense of these fossils.

Among professional paleontologists and biologists, nonbelievers—those who dispute that any definite animals are represented by the Ediacarans—will probably still be nonbelievers when they finish the book. Still, they will welcome the publication of *The Rise of Animals* because it is a one-stop shop for up-to-date information about this puzzling menagerie, and they will appreciate the beauty of its imagery and admire the persistence of our colleagues' efforts to learn more about what is ultimately paleontology's greatest riddle. Nonprofessionals will likewise find that it is a fine-looking book that captures the excitement of scientific discovery.

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