[American Journal of Science, Vol. 308, October, 2008, P. 954–956, DOI 10.2475/08.2008.04]

BOOK REVIEW

The Rise of Animals – Evolution and Diversification of the Kingdom Animalia; by MIKHAIL A. FEDONKIN, JAMES G. GEHLING, KATHLEEN GREY, GUY M. NARBONNE, and PATRICIA VICKERS-RICH, Baltimore, Maryland, The Johns Hopkins University Press, 2007, xvi + 327 pages, $75.00.—In spite of the title, this is not a book about the Cambrian Explosion but a general account of the large body fossils of the Ediacaran Period. As such it fills a major gap in the literature; fossils of this age have not enjoyed this kind of comprehensive illustrated treatment to date. The volume is spectacular, part coffee-table book, part academic treatise, and the result of collaboration between leading authorities in the field. Its large size and attractive production demand attention and no one could fail to be excited by the copious color photographs and occasional beautiful paintings by renowned Australian wildlife artist Peter Trusler.

Neoproterozoic stratigraphy and Ediacaran fossils are currently receiving much attention (this book is a spin-off of the UNESCO International Geological Correlation Program 493, which also led to the collection of papers on the rise and fall of the Ediacaran biota published by The Geological Society of London as *Special Publication* 286 in 2007). Ediacaran fossils occur on every continent except Antarctica. Their investigation is part of a focus on the early history of life driven by interest in the effects of Neoproterozoic glaciations, in the interrelationships of the major animal groups (using data from gene sequences and evolutionary development as well as from fossils), and in the possibility of life on other planets. New paleontological discoveries continue to promote research in the field.

Ediacaran fossils are difficult to interpret due to their unfamiliar morphologies and unusual modes of preservation. There is consensus, however, that the spindle and frond-shaped forms (rangeomorphs) that dominate the famous Mistaken Point assemblage in Newfoundland show a fractal-like organization (best illustrated by 3-dimensional specimens from Spaniard's Bay) that is unknown in other organisms, living or fossil. Dolf Seilacher interpreted these strange forms as members of an extinct group, the vendobionts, and he suggested more recently that a number of Ediacaran fossils may represent giant protists like the living xenophyophores. Other taxa, in contrast, such as the mollusk-like *Kimberella*, are similar enough to living animals to represent stem metazoans. Some 250 Ediacaran taxa are known, but their detailed interrelationships and affinities continue to be uncertain and controversial. One of the most useful parts of this book (at least to researchers) is the final section, an atlas that illustrates these taxa in alphabetical sequence from *Albumares* to *Zolotytsia*. Each entry includes data on occurrence, locality, rock unit, description, references, type specimen, and comments on affinities/classification. This atlas provides an up-to-date catalogue of the diversity of the Ediacaran fauna.

Part 1 of the book provides the background to the story. It reviews the nature of Planet Earth from its origins through the beginnings of plate tectonics during the Archean, the formation of the oceans and the atmosphere, and models for the origin of life. The account of the Proterozoic includes continental reconstructions (showing the formation and rifting of Rodinia). The appearance of eukaryotes and the nature of early macrofossils like *Grypania* and *Horodyskia* are reviewed, as well as the impact of the glacial periods on the history of life.

Part 2 treats the fossil sites. There are comprehensive accounts of the most famous assemblages: from the Avalon Peninsula of Newfoundland, the Flinders Ranges of South Australia, the White Sea of northern Russia, and southern Namibia. These are the most interesting chapters, with detailed narratives on the history of discovery and research (though none quite so remarkable as the story of Mrs. Walcott's horse stumbling on a block of Burgess Shale). The geology of each area and the biology of the organisms are also reviewed. Elkanah Billings described *Aspidella* from St. John's, Newfoundland, in 1872, but the Mistaken Point fossils were not discovered until 1967, nearly one hundred years later. *Rangea* and *Pteridinium* were described from Namibia by Gürich in 1930, although discovered earlier in the century. Reg Sprigg, working for the Geological Survey of South Australia, discovered Ediacaran fossils in the Flinders Ranges in 1946. Further finds prompted Martin Glaessner, professor at the University of Adelaide, to shift his attention from Tertiary microfossils to the Precambrian in the 1950s. He took on Mary Wade as a graduate student, and it was she, accompanied by Jim Gehling 'on his second fossil-collecting trip as an undergraduate volunteer', who found the now classic localities in Brachina Gorge. The Ediacaran macrofossils from the White Sea region were also discovered in the 1940s but in cores from deep bore holes; the first specimens in outcrop were not found until the 1970s. There followed a series of expeditions led by Boris Keller and then by Mikhail Fedonkin and others. Research on all these assemblages has seen a major resurgence in recent years.

In addition to chapters on the most important areas, there are accounts of Ediacaran discoveries in Podolia, Siberia, the Urals and northern Canada, and summaries of localities 'beyond the major sites' in the United Kingdom, western USA, North Carolina and South America. Surprisingly China is included in this last category, in spite of the importance (both realized and potential) of the Doushantuo Formation, which has yielded both macro and microfossils in contrasting facies – phosphorites, shales and cherts. The fossils in the phosphorites are perhaps the most extraordinary, including acritarchs, algae with preserved cell walls, and 3-dimensional animal embryos showing the earliest stages of cleavage. Although the record of embryos is apparently biased, these fossils may have the potential to allow integration of data on evolutionary development in living organisms with information from fossils. Chinese localities have also yielded larger Ediacaran organisms, some in carbonates; preservation in lithologies different from those in the classic areas may provide new evidence of morphology. Ediacaran trace fossils and microfossils are considered in Part 3.

The concluding part of the book attempts to relate the Ediacaran story to the Cambrian explosion. Different hypotheses for the affinities of the Ediacaran fossils are reviewed, including the diverse attempts at classification, but the nature of these large Neoproterozoic organisms remains enigmatic. Not only are their relationships to Cambrian animals unresolved, so too is the timing of the Cambrian radiation. Converging evidence, however, based on molecular and fossil data, indicates that sponges and cnidarians originated more than 600 million years ago whereas other major groups did not appear until the latest Neoproterozoic and earliest Cambrian. This chapter ends with a striking Peter Trusler rendering of the transition from Neoproterozoic matgrounds to Phanerozoic mixgrounds as postulated by Dolf Seilacher, and a series of photographs of Lower Cambrian fossils from Chengjiang in China.

As the first major synthesis of Ediacaran geology and paleobiology since Martin Glaessner's *Dawn of Animal Life* (1984) this is an important book. It is also very handsomely produced. It is a pity therefore that the effort and expense devoted to its production – a forward by Arthur C. Clarke, doyen of science fiction writers, generous color photographs, wonderful graphics by Draga Gelt, paintings by Trusler – are offset by some lapses in editing. The organization results in some repetition (each chapter in

Part 2 deals with the history of discovery and research in a different region and Part 4 attempts a synthesis). At the same time some topics seem to have fallen between the cracks. It is difficult to find out how the different Ediacaran biotas relate to one another, either stratigraphically or in evolutionary terms. There is little consideration of ecology. Some areas and localities are represented in maps and stratigraphic sections while others are not, some photographs of specimens lack a scale, a few figures are repeated in different chapters, and it is not clear why some illustrations were included at all. There seems to be little logic in the selection of topics for treatment in text 'boxes'. Notwithstanding these quibbles *The Rise of Animals* is destined to become a benchmark in our understanding of the earliest large organisms on Earth. Discoveries of more fossils, particularly those preserved in different styles, will continue to provide essential data. Future breakthroughs in understanding life in the Ediacaran, however, are likely to come from a focus on taphonomy (as a key to interpreting morphology), ecology and evolution, topics that should garner more attention in subsequent editions of this beautiful book.

Derek Briggs
Department of Geology and Geophysics
Yale University
New Haven, Connecticut, USA