

Book Reviews

Early Animals

The Dawn of Animal Life. A Biohistorical Study. MARTIN F. GLAESSNER. Cambridge University Press, New York, 1984. xii, 244 pp., illus. \$49.50. Cambridge Earth Science Series.

The Ediacarian fauna is an assemblage of mostly simple, soft-bodied animal fossils that occur in latest Precambrian rocks in many parts of the world. The recognition of these oldest animal fossils nearly three decades ago constitutes one of the great discoveries of modern paleontology. Prior to that time, paleontologists had searched Precambrian terrains in vain for bits of shell or impressions in rock that would represent the ancestors of the diverse skeletal fossils of Cambrian and younger strata. The resulting perception that Precambrian rocks were barren of animal fossils led to speculations that some major event or drastic change in the earth's environment propelled a unitary explosion of life some 570 million years ago, giving us the diverse marine faunas of the post-Precambrian Phanerozoic.

The realization that the Ediacarian fauna (actually first discovered in the early 1900's in Namibia) was Precambrian, coupled with the important discoveries of a complex record of microbial fossils extending back to 3.6 billion years ago, has greatly altered perceptions of the early evolution of life. Martin Glaessner has been one of the principals in this revolution. Beginning in the late 1950's he along with Mary Wade and other colleagues began describing (and redescribing) animal fossils found in sandstones underlying the Cambrian in the Ediacara Range of South Australia as well as in other parts of Australia, Namibia, England, and the Soviet Union. Glaessner, earlier than any other worker, realized the importance of these fossils for understanding the early history of life, and he has contributed numerous studies of their taxonomy, stratigraphic settings, biogeographic distribution, and general evolutionary patterns.

Glaessner summarizes this work and that of many others in his book on early animal life. The largest of the five chap-

ters in this book is devoted to a descriptive overview of the Ediacarian fauna. Representatives of the fauna have now been found at more than 20 localities throughout the world. For each of the major localities, Glaessner gives brief descriptions of both the body fossils and the trace fossils present and provides generalized locality maps and stratigraphic sections. Included is a valuable summary of Soviet work, which has been published almost exclusively in Russian. Throughout, Glaessner avoids technical systematic descriptions (these are contained in his 1979 contribution to Part A of the *Treatise on Invertebrate Paleontology*) and concentrates instead on the general characteristics of the fossils and their probable phylogenetic affinities. He concludes his overview with several important generalizations concerning the Ediacarian fauna: it is a homogeneous, worldwide fauna without distinct biogeographic or biostratigraphic subdivisions; it consists primarily of coelenterate-grade animals (two-thirds are medusoid or pennatulacean-like forms); and it is confined to a relatively short span of time, probably within the limits of 630 to 640 and 570 to 580 million years ago (the "Ediacarian" interval of earth history) and usually separated by more than 10 million years from the succeeding skeletal faunas of the Cambrian.

The remaining three chapters of Glaessner's book are devoted to the evolutionary and geological implications of the Ediacarian fossils. Several important theses form the core of these discussions. First, Glaessner believes that most Ediacarian animals can be related to members of later Phanerozoic faunas. In his taxonomic classification, many (but not all) medusoids are included among the Hydrozoa and Scyphozoa, frond-like forms are placed in or close to the anthozoan Pennatulacea, and segmented forms are classified with the Annelida (for example *Spriggina* and *Dickinsonia*) or the Arthropoda (for example *Praecambridium* and *Vendia*). This treatment has been challenged recently by some workers, notably Adolf Seilacher, who argue that many of the Ediacarian fossils have characteristics, such

as "quilted" morphologies, that preclude their inclusion in extant phyla. Unfortunately, these challenges emerged after the completion of the book and no counterarguments appear.

Another of Glaessner's principal theses is that the appearance of early animals was not a response to some extrinsic trigger or threshold that suddenly permitted animals to evolve. Glaessner rejects hypotheses that changes in such factors as oceanic chemistry, atmospheric oxygen concentration, or tectonic activity led directly to the early diversification of animal life. Instead, he argues that this diversification fundamentally reflects evolutionary experimentation and adaptation to ambient marine habitats. He argues this point not only for the soft-bodied Ediacarian metazoans but also for the Early Cambrian skeletal animals. With the latter discussion he provides another valuable overview of the earliest Cambrian (Tommotian) fossil record, again including a summary of Soviet work. Glaessner views these early skeletal fossils as phylogenetically distinct from the antecedent Ediacarian animals and as having replaced them during a Precambrian-Cambrian transition interval, during which new clades experimented with adaptations permitted by mineralized skeletons. No abrupt mass extinction of Ediacarian elements is suggested.

A final interesting, if minor, thesis in Glaessner's book is the idea that the earliest metazoans are much older than the Ediacarian fauna, appearing perhaps as early as 1000 million years ago. This thesis is based upon (i) the observation of a long gap between the oldest eukaryote fossils (1300 to 1500 million years old) and the earliest Ediacarian animals; (ii) the argument that the earliest metazoans would have been small, coelenterate or planuloid-grade animals with little potential for fossilization; and (iii) scattered and inadequately documented reports of fecal pellets, small burrows, and minute organic structures of possible metazoan origin in Upper Proterozoic rocks. Glaessner acknowledges that this evidence is far from definitive and urges further study.

Glaessner's book contains a wonderful variety of interrelated paleontologic data, stratigraphic observations, and evolutionary inferences, as has come to characterize the whole of Precambrian paleobiology. However, the book is not a definitive treatise on Ediacarian paleontology. As Glaessner cautions in his preface, he has attempted neither a thorough review of all literature nor a critical assessment of all hypotheses on early

evolution. But he has still produced a very valuable book for professionals and students wishing an introduction to the evidence, ideas, and literature on the early history of animal life or seeking inspiration for new areas of research at the bottom of the metazoan fossil record.

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A Cetacean Species

The Gray Whale. *Eschrichtius robustus*. MARY LOU JONES, STEVEN L. SWARTZ, and STEPHEN LEATHERWOOD, Eds. Illustrations by Pieter Arend Folkens. Academic Press, Orlando, Fla., 1984. xxiv, 600 pp. \$75.

The phenomenal upsurge in marine mammal research during the past decade is well exemplified by this volume that treats one of the most intensively studied species of great whale. Conveniently brought together are the results of 25 independent studies by 38 investigators (one Japanese, five Soviet, seven Canadian, and 25 American). The chapters are arranged under four general headings.

In the first section (Evolution, Fossils, and Subfossil Remains), L. G. Barnes and S. A. McLeod attempt for the first time to apply phylogenetic systematics to the baleen whales (suborder Mysticeti). They reaffirm the mysticete affinities of the problematic toothed *Aetiocetus* of the Oligocene (the allegedly related *Mirocetus* and *Ferecetotherium* are not mentioned). They also demonstrate that the traditional family Cetotheriidae is a non-monophyletic assemblage of early (Oligocene to Pliocene) baleen whales. The living mysticetes fall into four well-marked families: Balaenidae (right whales), Neobalaenidae (the pygmy right whale), Eschrichtiidae (the gray whale), and Balaenopteridae (rorquals). The polarity of the character-states that distinguish these taxa is discussed in detail. The distribution of apomorphic states reveals no unequivocal phylogenetic pattern. The authors criticize earlier ideas about the relationships among the mysticetes but do not try to resolve the phylogeny of either the living or the fossil taxa.

Although now living only in the North Pacific, the gray whale has long been known from subfossil remains in Europe. J. G. Mead and E. D. Mitchell now report 10 finds of gray whale bones from western North Atlantic beaches between

Long Island and Florida. Carbon-14 dating reveals that the most recent specimens died in the late 16th or early 17th century. These discoveries lend some plausibility to the contention that the enigmatic "scrag whale" of New England colonial times was the gray whale.

The second section (Historical Relationships and Exploitation) covers the aboriginal, old-style, and modern fisheries for gray whales. The six chapters here bring together much previously untapped archival material that will interest historians and anthropologists as well as cetologists. I. I. Krupnick's account of aboriginal whaling in Siberia and H. Omura's account of early Japanese whaling summarize information from published and unpublished sources that are otherwise practically inaccessible to Western researchers.

Part 3 (Demography, Distribution, and Migration) includes nine chapters, all of which deal with the eastern North Pacific ("California") population (the western or "Korean" population appears to be close to extinction). Because of their narrow coastal migration corridor and their circumscribed inshore winter range, gray whales are one of the easiest wildlife species to count. They have been systematically censused many times from vessels, aircraft, and shore, and the data have been subjected to elaborate mathematical analyses. Having been responsible for much of this research, I have been disillusioned to find that population estimates based on surveys of the winter grounds and those based on migration counts differ by a factor of two. There is an even greater discrepancy between estimates of calf production. Many possible biases in these estimates are discussed by S. B. Reilly. Jones and Swartz's five-year study at Laguna San Ignacio and J. D. Darling's 10-year study at Vancouver Island, based on observations and photographs of individually recognizable animals, indicate one of the most promising directions for research on cetacean population ecology.

In the last section (Biology and Behavior), A. V. Yablokov, L. S. Bogoslovskaya, and S. A. Blokhin report studies on age, growth, reproduction, stomach contents, and parasites of gray whales killed in the Siberian subsistence fishery; their data corroborate and extend previous research conducted in California. Other authors have investigated feeding, sound production, diving patterns, and movements. The variety of new techniques they have used suggests some of the potential for future field studies of live whales. Side-scan sonar allowed M.

Nerini to observe the impact of feeding whales on the benthic communities of the Bering Sea. Hydrophones revealed to M. E. Dahlheim, H. D. Fisher, and J. D. Schempp the diversified acoustic behavior of a species that less than 20 years ago was called "the quiet gray whale." Radio-tagging enabled J. T. Harvey and B. R. Mate to track a migrating whale for 6680 kilometers from Baja California to Unimak Pass, Alaska.

The editors have made it easy for readers to find their way among the wealth of new information. The table of contents and the running heads include both the titles and the primary headings of each chapter. At the head of each chapter is a complete outline of the contents. There is an adequate subject index, but names of organisms and authors are slighted.

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Meteoric Processes

Physics of Meteoric Phenomena. V. A. BRONSHTEIN. Reidel, Boston, 1983 (distributor, Kluwer Boston, Hingham, Mass.). xviii, 357 pp., illus. \$74. Geophysics and Astrophysics Monographs. Translated from the Russian edition (Moscow, 1981).

It has been over 25 years since the appearance of the classic theoretical monographs by B. Yu. Levin and the late E. J. Öpik on the phenomena that accompany the entry of meteoric bodies into the atmosphere of a planet. In *Physics of Meteoric Phenomena*, V. A. Bronshten has succeeded admirably in synthesizing and summarizing work done in this field since then. The topics covered will be of interest to workers in plasma physics, aerodynamics, radiation gas dynamics, meteoritics, meteor astronomy, and space science as well as to those concerned with middle and upper atmospheric physics, chemistry, and spectroscopy.

The author uses the model of simple ablation theory in a hydrostatic isothermal atmosphere as the context in which to view meteoric phenomena. What little is known regarding fragmentation and its eventual inclusion in a realistic way in the modeling process is considered in the last chapter of the book with an update in the last appendix of the English edition.

The book begins with a treatment of