BOOK REVIEWS

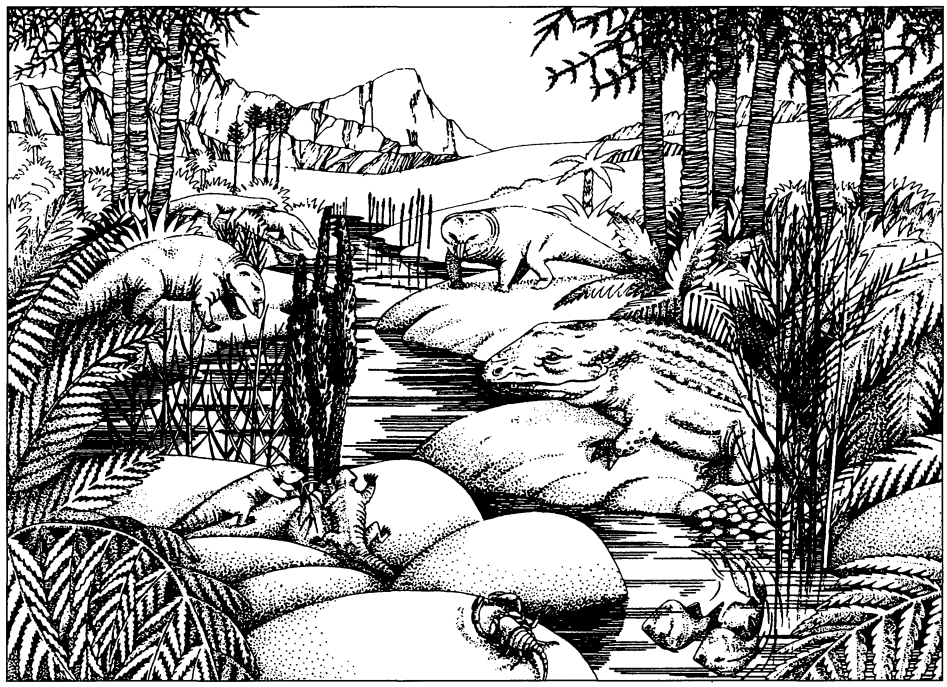
Ancient Smaller Vertebrates

In the Shadow of the Dinosaurs. Early Mesozoic Tetrapods. NICHOLAS C. FRASER and HANS-DIETER SUES, Eds. Cambridge University Press, New York, 1994. x, 435 pp., illus. $89.95 or £50.

The history of life can be viewed as a time-ordered sequence of biological and physical events recorded primarily in rocks and fossils. The events of any given time interval are not like those of any other because life on Earth changes with time and the configuration of physical parameters changes as well. The two are not independent. Fossils demonstrate biotic change through time. The information content of long-chain protein or nucleic acid molecules exposed by comparing those of different species also has temporal implications, but the implications emanate from only one time horizon—the present—and can only accommodate, for the most part, species that have not been afflicted by the scourge of extinction. For all clades of organisms currently on Earth, there was at least one species that survived the extinction events of the past. The beauty of fossils is that they can tell us both about the ones that made it and the ones that did not. That is what makes paleontology as a science fundamental to understanding the Earth and the life on it.

No interval of geologic time or group of organisms is without interest for the history of life; however, *In the Shadow of the Dinosaurs* delves into an interval and a set of vertebrate species that is particularly relevant to the biodiversity of the modern world. It focuses on the Late Triassic and Early Jurassic periods, around 200 million years ago, a time when modern groups of tetrapods were originating. It also focuses on tetrapods of small body size. Though that group includes early representatives of modern tetrapod clades, many other vertebrate clades also have members with small body size. In fact, the dinosaurs of that time interval were not all that large for the most part, and they are included in some of the papers in this volume. The book title is more figurative than literal, a reflection on the perceived emphasis of one part of the fossil record over another.

This well-illustrated book is divided into three sections: on phylogeny, on faunal assemblages, and on faunal change. The first section includes strong contributions dealing with the cladistic relationships within Amphibia, including frogs and other lissamphibia, within the lepidosauromorphs, including squamates (lizards and snakes), within the crocodyliforms, and within early mammals. There are plenty of archaic and extinct members of each of these groups, but this section as a whole gives a very nice picture of the phylogenetic relationships of these modern groups, emerging from within a much more unfamiliar biological milieu.



"Reconstructed scene during the Middle Triassic in Devon, based on specimens from the Otter Sandstone Formation between Sidmouth and Budleigh Salterton. A scorpion (mid-foreground) contemplates a pair of procolophonids on the rocks. Opposite them, a temnospondyl amphibian has spotted some paleonisciform fish, *Dipteronotus*, in the water. Two *Rhynchosaurus* stand in the middle distance, and behind them a pair of rauisuchians lurk. The plants include *Equisetites* (horsetails) around the waterside and *Voltzia*, a conifer tree." [Drawn by Pam Baldaro, based on her color painting; from M. J. Benton *et al.*'s chapter in *In the Shadow of the Dinosaurs*]

The second section deals with the fundamental aspects of time, place, and association of species. The treatment is global in perspective but with contributions limited (in title) to North America (including Mexico), Europe, and China. This section is important because the when, where, and with whom of the fossils provide the raw data from which the more speculative discussions in the final section derive. In this second section, however, we can see clearly the effects of alternative approaches to deciphering the fossil record. For example, Kaye and Padian enumerate morphological groups of fragmentary microvertebrate fossils, discuss their significance and affinity, and document diversity but refrain from naming new taxa because the addition of a name to the literature based on fossils taxonomically unsuited to be designated holotypes would add little in the long run. On the other hand, Hunt and Lucas name four new genera and three new species of ornithischian dinosaurs on the basis of minimal samples of similar isolated teeth. A chapter from the concluding section that provides an interpretative field guide to Late Triassic tetrapod sites in Virginia and North Carolina could easily have been accommodated in this section.

The emergence of modern groups of tetrapods in the Mesozoic Era is not uncomplicated. It rests within a swirl of changing environments, originations, and extinctions. The origins of modern tetrapod clades are obfuscated by difficulties in correlation and dating and a fossil record plagued by alternative interpretations of the significance of known stratigraphic distributions. That is what provides the challenge. Ex-

tinctions clearly occurred by the end of the Triassic Period, but exactly when, or how many major extinction events occurred, is still open to vigorous discussion. This is exemplified in chapters by Simms *et al.* and by Benton and in a well-reasoned summary by Padian. At issue are the number of extinction events—one or two—at the end of the Triassic, whether marine extinction coincides with extinction in the terrestrial realm, and even the possibility of an extraterrestrial cause for terminal Triassic extinctions. This is good stuff. And out of that time—somehow—spring the major tetrapod groups of our modern world.

In a humorous mutation of the parable of the blind men and the elephant, Padian compares the investigation of Late Triassic vertebrate-bearing terrestrial sediments to an attempt to understand the workings of an internal-combustion engine by using blueprints of six different kinds of engines torn into jigsaw puzzles and with some pieces missing. I am not much of a grease monkey myself, but I appreciate the Earth as an engine that works. As a manual to begin investigating the workings of the Late Triassic and Early Jurassic world, this is a good book.

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Chemical Paperwork

Molecular Origami. Precision Scale Models from Paper. ROBERT M. HANSON. University Science, Sausalito, CA, 1995. xvi, 223 pp., illus. Paper, $22.

Chemical structures have to be understood in three dimensions, yet books and blackboards are in two, so chemistry classrooms and labs are often decorated with molecular models made of plastic, styrofoam, and the like. Many students purchase modeling kits that allow structures with "standard" bond lengths and angles to be constructed. Trickier structures, such as ones with fivefold symmetry or unusual bond lengths, can be difficult to construct, and the nuances of different structures are lost in an effort to ease the task of construction.

Hanson takes an approach that requires more patience and dexterity but likely yields a more satisfying learning experience. He has developed a workbook for constructing paper models of molecules, which he calls "molecular origami." Each structural type is introduced within the framework of molecular orbital theory, but Hanson emphasizes that the models, which reproduce the known bond lengths and angles, make no assumptions about bond orders or unpaired electrons. Instead, theory must be used to understand why the structures result. Thus the student can make models of NH_3, NF_3, and PF_3 and interpret the changes in bond lengths and angles. A series of questions are included with the simpler structures, and an answer guide is provided. More than 70 structures are explored, including coordination compounds such as iron carbonyl [$Fe_2(CO)_9$], network solids such as silicates, and even the highly complex shapes of C_{60} and the boron hydrides.

Clear instructions are given for the actual cutting, folding, and taping of the models; making some of the "inside" folds on the more complicated shapes is facilitated by putting a straight edge (ruler or business card) under the paper. The examples should prove useful in teaching chemical bonding concepts not only in high school and freshman chemistry classes but also in undergraduate inorganic chemistry. The models could also aid physical chemists looking for structural models to illustrate symmetry concepts in the application of group theory.

Phillip D. Szuromi

Vignettes: Sea Changes

Some inspired pack of rhipidistians or Dipnois came ashore for the first time in the late Devonian, either looking for a meal or trying to avoid becoming one. Maybe they were pursuing the as yet unknowable vertebrate dream of a future filled with cheeseburgers, pizza, Caesar salads, decent wine, homes of their own, and a new car every two years.

—*Brad Matsen*, in *Planet Ocean: A Story of Life, the Sea, and Dancing to the Fossil Record* (Ten Speed Press)

Cruise the aisles of a grocery store and it's hard to find many products without algae and algae byproducts. Alginates help keep beer foam from collapsing when it comes in contact with lipstick. The same alginates keep pimentos firm in green olives, stabilize pulp in juice concentrates, thicken instant soups, and substitute for oil and eggs in no-fat mayonnaise. Carrageenan is used as a stabilizer in air freshener gels, anti-icers, breads, infant formula, liquid cleanser, and pumpkin pie. Betacarotene pigment provides a natural yellow-orange food coloring for cheese, butter, beverages, pastries, and popcorn. Agar is found in canned meats, jellies, and marshmallows. And in the foreign food aisle you might find dried algae.

—*Michael Weber* and *Judith Gradwohl*, in *The Wealth of Oceans* (Norton)

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Books Received

Adult T Cell Leukemia and Related Diseases. Takashi Uchiyama and Junji Yodoi. Landes, Austin, TX, and Springer-Verlag, New York, 1995 (distributor, CRC Press, Boca Raton, FL). vi, 139 pp., illus. $59. Medical Intelligence Unit.

Advanced Calculus of Several Variables. C. H. Edwards, Jr. Dover, New York, 1995. xii, 457 pp., illus. $13.95. Reprint, 1973 ed.

Advances in Acoustic Microscopy. Vol. 1. Andrew Briggs, Ed. Plenum, New York, 1995. xxxii, 350 pp., illus. $79.50.

The Ages of Gaia. A Biography of Our Living Earth. James Lovelock. Norton, New York, 1995. xxii, 255 pp., illus. Paper, $12 or $C16. Reprint, 1988 ed.

Aging. A Natural History. Robert E. Ricklefs and Caleb E. Finch. Scientific American Library (HPHLP), New York, 1995 (distributor, Freeman, New York). xiv, 209 pp., illus. $32.95.

AIDS Update 1994-1995. An Annual Overview of Acquired Immune Deficiency Syndrome. Gerald J. Stine. Prentice Hall, Englewood Cliffs, NJ, 1995. xlvi, 381 pp., illus. Paper, $18.67. Alternate version of *Acquired Immune Deficiency Syndrome* (1995).

Bats. A Community Perspective. James S. Findley. Cambridge University Press, New York, 1995. xii, 167 pp., illus. $19.95. Cambridge Studies in Ecology. Reprint, 1993 ed.

Benzodiazepine Receptor Inverse Agonists. Martin Sarter, David J. Nutt, and Richard G. Lister, Eds. Wiley-Liss, New York, 1995. x, 304 pp., illus. $75.

Biology of Microorganisms. Thomas D. Brock *et al.* 7th ed. Prentice Hall, Englewood Cliffs, NJ, 1994. xviii, 909 pp., illus. $73.

Birth Control Vaccines. G. P. Talwar and Raj Raghupathy. Landes, Austin, TX, 1995 (distributor, CRC Press, Boca Raton, FL). xii, 171 pp., illus. $79. Medical Intelligence Unit.

Braving the Elements. Harry B. Gray, John D. Simon, and William C. Trogler. University Science, Sausalito, CA, 1995. xiv, 418 pp., illus. Paper, $29.50.

Calculating the Secrets of Life. Applications of the Mathematical Sciences in Molecular Biology. Eric S. Lander and Michael S. Waterman, Eds. National Academy Press, Washington, DC, 1995. xiv, 285 pp., illus. $39.95.

Captain James Cook. Richard Hough. Norton, New York, 1995. xviii, 398 pp. + plates. $29.95 or $C37.99.

Carbon-13 NMR Spectroscopy of Biological Systems. Nicolau Beckmann, Ed. Academic Press, San Diego, CA, 1995. xx, 334 pp., illus. $69.95.

Catching the Light. The Entwined History of Light and Mind. Arthur Zajonc. Oxford University Press, New