Phanerozoic Geology

Paleomagnetism of the Atlantic, Tethys and Iapetus Oceans. ROB VAN DER VOO. Cambridge University Press, New York, 1993. x, 411 pp., illus. $89.95 or £60.

While hiking in the high country or cruising on Interstate 95, you probably have crossed paths with a paleomagnetician or two without knowing it. In the opening passages of John McPhee's *Basin and Range*, morning traffic in New Jersey moves slowly eastward along the western approach to the George Washington Bridge and the Palisades Sill is exposed in massive roadcuts. A glance to the side reveals that "everywhere, in profusion along this half mile of diabase, there are small, neatly cored holes, in no way resembling the shot holes and guide holes of the roadblasters, which are larger and vertical, but small horizontal borings that would be snug to a roll of coins. These were made by geologists taking paleomagnetic samples."

Thousands of small core samples taken by hundreds of scientists and graduate students around the world each year form the foundation for Rob Van der Voo's *Paleomagnetism of the Atlantic, Tethys and Iapetus Oceans*. The clearly visible successes of paleomagnetic research include the confirmation of continental drift and the advance of plate tectonic theory, cornerstone issues that were developed in classic but now dated texts on paleomagnetism by Irving (1961) and McElhinny (1974). Although several other books on the subject have been published in recent years, Van der Voo's stands out because it distills and refines almost 30 years of research and scholarship devoted to the application of paleomagnetism to tectonics in general and to the geological evolution of the Atlantic-bordering continents in particular.

Van der Voo reminds us with an anagram that Paleomagnetism is also Not A Simple Game. Though a few introductory remarks about experimental technique and data interpretation are presented, those with little or no prior experience in paleomagnetism would do well to begin by reviewing R. Butler's introductory text *Paleomagnetism* (1992). The remainder of Van der Voo's book is a comprehensive and balanced paleomagnetic view of the evolution of the supercontinent Pangea, the Mesozoic opening of the Atlantic Ocean, and the closure of the Tethys to form the Alpine-Himalayan mountain chain. Van der Voo has painstakingly ranked and winnowed vast quantities of published data of variable quality, casting out less reliable information and merging the best paleomagnetic results with an informed structural and tectonic opinion. His book includes not only an extensive bibliography but a 73-page appendix where readers will find paleomagnetic data for Pangea and Gondwana neatly summarized, ranked for reliability, and referenced. The numerical rankings given in the appendix and justified earlier in the text are an excellent starting point but should not be substituted for careful reading of the original works and informed personal judgment.

The clever artwork on the cover of the book made me hope that equivalent attention had been given to the design of the 188 figures and photos found inside. Eighty figures are original but frequently not well done (the hand-drawn decaying sinusoid depicting alternating-field demagnetization is perhaps the least attractive), and the remainder are either taken as is or redrawn from previous publications. Some of the photographs seem to have little point, such as a picturesque Alpine village near a place where some interesting paleomagnetic data were collected, and the mixture of graphical styles is often rather jarring to the eye.

These deficiencies of appearance in no way detract from the wisdom, insight, and occasional wit contained in the text. Van der Voo's book is *de rigueur* for the paleomagnetician's bookshelf along with the classic works by Irving and McElhinny, and tectonics specialists will find it an invaluable reference in the use and interpretation of paleomagnetic data for continental reconstruction, paleogeography, and relative plate motion. Other readers on their way to the beach or the mountains this summer will now know why those little holes are there in the rock.

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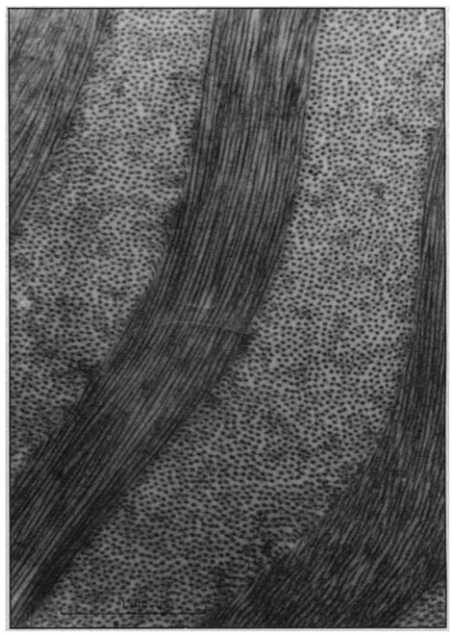
Structural Materials

Biology of Fibrous Composites. Development Beyond the Cell Membrane. A. C. NEVILLE. Cambridge University Press, New York, 1993. viii, 214 pp., illus. $64.95 or £35.

Charles Neville has been studying liquid crystalline structures in nature since he first recognized them in the early 1960s. He has been collecting beer bottles (full as well as empty) for even longer and has in his garage the biggest collection of them I have ever seen, including some exhibition ales nearly 100 years old. Neville has collected scientific references with the same glee, so I was not surprised to find over 500 in this slim volume. And I bet you Neville can quote them all, down to the volume and page number of the journal!



"Electron micrograph of a section through the cornea of an amphibian eye (common frog, *Rana temporaria*). The collagen fibrils form a neat orthogonal plywood. Micrograph courtesy of the late Dr. J. N. Lythgoe." [From *Biology of Fibrous Composites*]

This type of tenacity and enthusiasm makes all Neville's publications interesting and useful, and this book is no exception. Neville wants to know what happens to structural biological materials once they leave the confines of the cell. He does not, therefore, deal with keratins, but includes all plant materials, collagen, bone, insect cuticle, and so on. The underlying theme is the self-assembly (which Neville convincingly differentiates from crystallization) of biological composites into structures with the morphology of liquid crystals, more particularly with twisted nematic (that is, cholesteric) architecture. If you have not met helicoids before, you cannot fail to be charmed by their morphology and amazed by their pervasiveness. There is hardly a corner of the biotic world that does not harbor a helicoid.

With the words "fibrous components" in the title, I was expecting to find an exposition of the application of composite theory to these materials, but what little mathematics there is concerns the fascinating optical properties of beetle cuticle, which can appear metallic and mirror-like owing to its structure. What I did find was a selection of excellent photographs and diagrams and a large number of useful and exhaustive tables, which together show

that these materials play a more dynamic part in developmental biology than is generally appreciated. For instance, the net orientation of cellulose fibers in the cell wall of a plant controls the direction in which the cell will expand, so it is at this level that we have to explore the control of shape of the plant in growth (both at the meristem and an increasing size) and wound healing. This adaptation of directional properties applies to insects in all stages, egg to adult; to cysts and egg capsules of a huge variety of animals; to silk; and to nutshells and to bone. We still do not know how the orientations are achieved or controlled, but with such a wide variety of materials and mixtures capable of self-assembly, there is likely to be a variety of mechanisms. Neville devotes a chapter to this problem and recognizes two main classes—remote (chemical) control and more immediate directed control, where cellular structures can be seen to match with those of the extracellular material. A further possibility is mechanical orientation. The chapter on biomimicry interestingly introduces more artificial liquid crystalline materials but regrettably says little about how they might be used.

There are a few elementary mistakes, such as the generalizations that all mammalian bone is osteate, that the roots of plants carry virtually no stresses, that glass fibers are brittle because they have small scratches on the surface, and that the high resilience of resilin can only be due to the randomness of arrangement of its constituent chains. These errors do not reduce the impact of the work, which is full of insight. For instance, only with the evolution of cell walls made with fibers ordered in such a way as to support large forces can plants have developed sufficient rigidity to support themselves and become large. Can one see these orientations in the petrified cell walls of *Rhynia*, that famous first land plant? As usual, Neville is generous with his ideas and produces blueprints for a dozen or so projects, some to be pursued in well-known holiday resorts. This book is such a good read that I wouldn't mind taking it along too.

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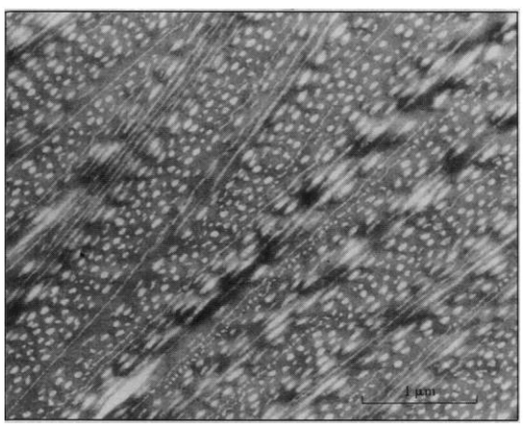

"Transmission electron micrograph of a section through the eggcase protein of a praying mantis (*Sphodromantis tenuidentata*). This was fixed *in situ* in the oothecal gland and was in a liquid crystalline phase prior to fixation. The system is seen to be orthogonal. From work by B. M. Luke and A. C. Neville. Stained with uranyl acetate and lead citrate." [From *Biology of Fibrous Composites*]

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Other Books of Interest

Science Advice to the President. WILLIAM T. GOLDEN, Ed. Second edition. AAAS Press, Washington, DC, 1993. xii, 329 pp. Paper, $29.95; to AAAS members, $23.95.

Science and Technology Advice to the President, Congress and Judiciary. WILLIAM T. GOLDEN, Ed. Second edition. AAAS Press, Washington, DC, 1993. xxiv, 529 pp. Paper, $29.95; to AAAS members, $23.95.

The efforts of William Golden in the years just after the Second World War were instrumental in establishing a mechanism for science advice to the U.S. presidency that has continued, with various interruptions and modifications, to the present day. In 1980 Golden brought together under the title *Science Advice to the President* (Pergamon Press) a collection of observations and reflections by those who had served as presidential science advisers and by other knowledgeable commentators (see *Science* **209**, 371 [1980]). This was followed by two further compendia expanding the scope of the coverage: *Science and Technology Advice to the President, Congress, and Judiciary* (Pergamon, 1988; see *Science* **239**, 1077 and 1082, and **240**, 1552 [1988]) and *Worldwide Science and Technology Advice to the Highest Levels of Government* (Pergamon, 1991; see *Science* **252**, 1565 [1991]). The first two of these works have now been reissued, reprinting without change the contents of the original versions but with new prefatory material and some additions to cover more recent developments.

The principal additions to *Science Advice to the President* are contributions from the two most recent presidential advisers, John H. Gibbons and D. Allan Bromley. Gibbons proffers four pages on "President Clinton's first 100 days," optimistic in tone but "draw[ing] few conclusions from [his] experience to date." Bromley, who served in the Bush administration, provides an essay of some 40 pages (a harbinger of his book-length memoirs soon to be published under the title *The President's Scientists* by Yale University Press) in which he comments on issues ranging from office location and personnel recruitment through earmarking, science and mathematics education, "critical technologies" enterprises, environmental affairs (especially the Nordwijk and Rio conferences), and international issues related to science and technology. He also provides a list of key figures of the Bush-era science apparatus. In addition to the contributions by Gibbons and Bromley, John McTague, who served briefly under Reagan, provides a few paragraphs on events of his tenure.

In the new version of *Science and Technology Advice* the original 85 articles are augmented by an account of the efforts of the Carnegie Commission on Science, Technology, and Government (1988–1993), of which Golden, with Joshua Lederberg, was co-chairman. The commission focused its analysis on the decision-making apparatus rather than specific policy issues, and in a chapter added at the end of the book Golden lists the categories of organizations examined, summarizes activities focused on the three branches of the federal government and state governments, names members and other associates of the commission, and lists publications resulting from its activities. As does its companion volume, the book has a name but not a subject index.

—Katherine Livingston

A Positron Named Priscilla. Scientific Discovery at the Frontier. MARCIA BARTUSIAK and eight others. National Academy Press, Washington, DC, 1994. viii, 348 pp., illus., + plates.

This is a book conceived in the spirit—and presumably as an offshoot—of the National Academy of Sciences' "Frontiers of Science" symposiums, which (in the words of Bruce Alberts's foreword) bring together "some of the nation's and the world's top young researchers . . . to report on their current work to peers *outside* their discipline." Here, however, the intended audience is larger—"everyone interested in the course of science"—and the expositors are "top science writers." In the essay that gives the volume its title T. A. Heppenheimer discusses the "trapping and manipulating" of atoms and subatomic particles by optical and magnetic means (Priscilla being a captive of Hans Dehmelt). Heppenheimer also contributes a paper on the top quark and Higgs particle, and Elizabeth Maggio writes about fullerenes. Methods of studying the sun's interior, discoveries due to the Magellan