theories on subjects such as the source of the channels, variations in past Martian climate, or the interpretation of crater counts but also to show how these theories evolved and to weigh pros and cons as necessary.

The book is comprehensive and profusely illustrated. Contrary to the title, there is discussion not only of the surface of the planet but of the atmosphere and satellites as well. Topics include the outgassing history, volcanoes, tectonics, gravity data, the forms and history of the channels, and the distribution of volatiles. There is a special chapter on the search for life, reprinted from a 1979 summary by Harold P. Klein, who headed the Viking biology team.

Carr not only reviews, he synthesizes, and his conclusions are in the mainstream of current thinking. Carr's Mars has cratered plains formed nearly 4 billion years ago when Mars may have had a thicker atmosphere. Some dendritic channels nearly that old are probably runoff channels caused by water flow. Tharsis volcanism was already under way 3 billion years ago, when some large outflow channels may have formed. The Tharsis lava plains, many canyon systems, and some of the complex fretted channels, caused by mass wasting of earlier channels, may date back to 1 to 2 billion years. The huge volcanoes, Olympus Mons and its companions, were probably active within the last 1 billion years, and the stratified sediments of the polar regions have windblown surfaces as young as a few hundred million years. Permafrost is everywhere. Throughout the book crater counts and other numerical data are provided to support the geological interpretations.

I object somewhat to the unwieldy format (about 12 by 12 inches), given that only about 21 of some 184 illustrations take full advantage of page width and only a lunar photo bleeds to three edges of the page. Figure 10.6 of chaos and channels is upside down, and p. 197 refers to 1877 as the year when "Antoniadi first reported seeing canals"; it was really Schiaparelli who noted them then (as correctly stated on p. 2), and they were sketched even earlier.

A final quibble: Why is it that just because a spacecraft lands with one leg on a rock its photographs are reproduced forevermore with crooked horizons? If Ansel Adams got one of *his* tripod legs on a rock, he'd crop the picture to get a straight horizon. As we try to describe planets as real places to the public, understandable, rather than cockeyed, views of planetary landscapes are important. So I wish that the cover photo and figure 11.8 had horizontal horizons. It's hard enough to hold a 12 by 12 inch tome straight without crooked horizons!

As exploration of our cosmic environment falters owing to federal-funding reversion to 19th-century technology (coal, oil, and guns), this book stands as a useful memorial to the first golden age of Martian exploration, and it is a masterly summary of questions that will surely be probed by future explorers.

WILLIAM K. HARTMANN
*Planetary Science Institute, Tucson, Arizona 85719*

## The Oceans

**The Sea Floor**. An Introduction to Marine Geology. E. SEIBOLD and W. H. BERGER. Springer-Verlag, New York, 1982. viii, 288 pp., illus. Paper, $20.

**Marine Geology**. JAMES P. KENNETT. Prentice-Hall, Englewood Cliffs, N.J., 1982. xvi, 814 pp., illus. $34.95.

These two complementary books are a welcome addition to a field lacking such texts for over 20 years. Although both books treat aspects of crustal structure and geophysical methodology, the treatments serve mainly as a structural framework for the major focus: the impact of plate tectonics on the circulation of the oceans and on world climate. The evidence of this impact lies in the sediments of the sea floor, but the ultimate payoff lies in interpretations of changing ocean circulation over the last 200 million years as the ocean basins evolved toward their present shapes. Both books concentrate on the Mesozoic and Cenozoic record (rather than on the Paleozoic history, which is stressed in Schopf's recent *Paleoceanography*, or the modern ocean, which is the focus of Gross's *Oceanography*, a third edition of which has just appeared). The authors are all well-known generalists with diverse research experience.

The Seibold-Berger book is intended as a brief overview of the field and would most usefully serve the academic community as a first-level checklist for teachers just creating undergraduate or graduate courses. It is also intended to reach those without formal training in the field. Although I find it difficult to envisage this wider readership's being drawn to a basically academic-style text, the writing makes some concessions to a wide audience by generally moving quickly to the major messages without lingering over details and methodology. But the illustrations are wholly from academic sources, with no allowance made for an audience accustomed to the glossy pictorial style of the new science magazines.

The book grew out of an earlier edition in German by Seibold, with updating and expansion by Berger. The newer sections are in general roughly attached to the older, with the seams showing. The older portions of the text treat the major findings in plate tectonics with admirable balance and historical sensitivity, and the figures from the classic papers are well chosen. Some of the older parts (those on sediment origin and dispersal, for instance) appear not to have been brought up to date at all. Updated or newly written sections convey much of the excitement generated during the last decade by the rapidly expanding knowledge of sea-floor history. The science presented is for the most part solid, except for minor eruptions of personal overenthusiasm (for example, the rather doubtful "global meltwater spike" hypothesized by Berger for the last deglaciation). Scientific errors are relatively rare (an example of such an error is a misidentified continental slope on p. 37), but mechanical mistakes are more numerous—perhaps two dozen typos including several *ist*'s slipping through from the German version. All in all, this is an enthusiastic but hastily done effort for a somewhat uncertain audience.

Kennett's book was heralded by a remarkable advertising flier ("When . . . it's a book by James Kennett, you're confident"). Kennett apparently is a legend at Prentice-Hall because of having met all 19 chapter deadlines. Perhaps intending a reward, Prentice-Hall created the Kennett-confidence persona, leaving others in the field to ponder uneasily what alliteration might grace their own names.

The book is a major success. The scope is broad, the depth substantial, the writing and figures clear, and the price surprisingly reasonable for so full an effort. The references are even current well into 1981. Teachers will find this an excellent and useful textbook with, if anything, more detail than they need. The first quarter of the book establishes basic concepts in the diverse subjects of geophysical methodology, time and stratigraphy, plate tectonics theory, crustal composition, and oceanic circulation. Kennett next discusses continental margin types and sea level history, moves to the deep sea to focus on the open ocean record, and finishes with an extensive

discussion integrating all these lines of knowledge into a paleoceanographic history of the ocean basins.

Criticisms are largely of second-order importance. Kennett tends to rely on last-big-synthesis articles as source references rather than on the papers that made the original breakthroughs. In many cases, he writes most clearly when the subject matter is more distant from his research specialties. Closer to his own interests, the style at times tends toward long descriptive narratives that can be difficult to follow. One flaw is more significant: for a book focused on paleoceanography, the climatological treatment of modern oceanography is too thin. Missing is some important material, much of it recent, on regional transport and air-sea exchange of heat. This kind of base-line understanding of the modern climate system is of fundamental importance to a book so heavily devoted to climatic interpretations of Cenozoic oceanographic phenomena. Similarly, there is more room for base-line treatment of recent developments in plankton ecology and particle flux, particularly the results from sediment traps, multiple tows, and large-volume filtration.

This material could be added to a second edition at the expense of the occasionally excessive amount of geotectonic classifying and categorizing (especially of continental margin types) and arguably superfluous nomenclature ("megasutures," "offscraping," "ecospace"). Fundamentally, however, this is an authoritative work from a scientist obviously committed to the final product. Congratulations to Kennett.

WILLIAM F. RUDDIMAN
*National Science Foundation, Washington, D.C. 20550*

## Continental Margins

**Dynamics of Passive Margins**. R. A. SCRUTTON, Ed. American Geophysical Union, Washington, D.C., and Geological Society of America, Boulder, Colo., 1982. vi, 200 pp., illus. $15. Geodynamics Series, vol. 6.

*Dynamics of Passive Margins* is the final report of one of the ten groups through which the work of the decade-long geodynamics project (jointly sponsored by the International Union of Geological Sciences and the International Union of Geodesy and Geophysics) was organized between 1970 and 1980. This group dealt with the origin, evolution, and structural state of Atlantic-type continental margins, those formed by the breakup of larger bodies such as Gondwana and Laurasia.

I can think of at least three other books devoted, or mainly devoted, to the evolution of Atlantic-type margins that have appeared in the last few years. However, the editor of this one has avoided duplication by emphasizing some aspects that have not been widely discussed in the other books. For example, very different papers by Kosminskaya on Soviet geophysical studies in the Arctic and North Atlantic and Sweeney on studies of the Canadian Arctic margin emphasize that data acquisition is still the dominant problem in Arctic ocean geology. In the face of admittedly slender data, Sweeney opts for an origin of the Canada basin by rotation of the north slope of Alaska (and I would ask, perhaps the Chukotsk and the New Siberian block also?) about a pole near the MacKenzie delta during the early Cretaceous. Suturing of an earlier ocean he attributes to mid-Paleozoic collision between part of Siberia and North America roughly along the line of the coast of the Arctic Islands. These two suggestions fit well with the data in Sweeney's regional geophysical maps and five sections across the Arctic margin and provide a coherent working hypothesis for Arctic evolution.

Keen reviews eastern Canada, again with five sections across the margin, and considers thermal subsidence using data from eight oil wells. She points out that, although we are becoming skilled at modeling the thermal behavior of Atlantic-type margins (at least five practitioners of this skill contribute to the report), we do not yet deal well with early rifting phases. She also pleads for more studies of conjugate margins and of ancient Atlantic margins exposed in mountain belts. Long and Lowell address the slow subsidence of continental fragments isolated near Atlantic margins and find that they are able to model it simply in terms of the greater heat generation of the continental material.

The evolution of the margins of northern Europe, eastern Greenland, Australia, and East and West Africa are all well reviewed with good summary maps and cross sections. Dingle, in discussing Africa, finds that a mid-Cretaceous change from rift to broader basin subsidence (commonly called the steer's head relationship) is universal and finds in this support for Kent's remarkable suggestion of a "fundamental rheological modification of the crustal rocks" at this time. Sloss also argues for episodicity because he finds that rapid subsidence in intracontinental basins tends to coincide with marginal rapid subsidence. He invokes a process of subcontinental melting and uplift (which reminds me of Krenkel's ideas of 60 years ago) alternating with outflow of material from beneath the continents to cause regional subsidence. Alternations of the two processes produced $10^8$-year cycles during the older Paleozoic.

Turcotte considers the state of stress at Atlantic margins, pointing out that elevation and density contrasts are sufficient to maintain substantial stresses even on old Atlantic margins. He suggests that this may account for a concentration of volcanoes at these margins, which is not as obvious to me as it is to him.

Bott considers the origin and distribution of stress on Atlantic margins and in the preceding rift state. The latter he regards as harder to interpret, but he suggests that the suction force exerted on an overriding plate during peripheral subduction may have been important in leading to the breakup of Pangea.

Scrutton provides a review of the decade's achievements. Most notable has been success in understanding subsidence generated by the processes of sediment loading and cooling at the margins. Scrutton also contributes a paper on strike-slip boundaries, a topic he has made his own.

The publishers and the authors have produced for $15 a hardbound, informative summary of our present state of knowledge that will prove useful in addressing the next decade's main problem, which I see as an understanding of along-strike variations at Atlantic margins.

KEVIN BURKE
*Lunar and Planetary Institute, Houston, Texas 77058*

### Books Received

**Ability Testing**. Uses, Consequences, and Controversies. Alexandra K. Wigdor and Wendell R. Garner, Eds. National Academy Press, Washington, D.C., 1982. Two volumes. Part 1, Report of the Committee. x, 242 pp. Paper, $13.95. Part 2, Documentation Section. x, 414 pp. Paper, $24.95.

**Adaptive Radar in Remote Sensing**. Dag T. Gjessing. Ann Arbor Science (Butterworth), Ann Arbor, Mich., 1981, xii, 154 pp., illus. $27.50.

**Advances in Genetics**. Vol. 21. E. W. Caspari, Ed. Academic Press, New York, 1982. viii, 374 pp., illus. $36.

**Advances in Neuroendocrine Physiology**. K. B. Ruf and G. Tolis, Eds. Karger, Basel, 1982. vi, 140 pp., illus. $58.75. Frontiers of Hormone Research, vol. 10.

**Advances in Nutritional Research**. Vol. 4. Harold H. Draper, Ed. Plenum, New York, 1982, xiv, 344 pp. $39.50.

**Algorithms for Graphics and Image Processing**. Theo Pavlidis. Computer Science Press, Rockville, Md., 1982. xviii, 416 pp., illus. $24.95.

**The Alkaloids**. Chemistry and Physiology. Vol. 20.

*(Continued on page 908)*