

89-5

off, then transferred by ocean spreading processes across a substantial part of Tethys, eventually colliding with and becoming attached to Laurasia. The tectonic collage of southeast Asia is thus traced to northern Australia. Such events imply not only the subduction of a great deal of ocean floor but also the addition of much continental material to Laurasia at the expense of Gondwana. The editors of this book point out that concomitantly with such tectonic processes, "a series of substantial continental fragments was being swept across Panthalassa, to dock on the western margins of North America." Clearly, a dominant process in global tectonic renovations involved transoceanic dispersal of terranes.

*Gondwana and Tethys* integrates diverse geologic disciplines as it explores the progressive dispersal of Gondwana's subcontinental fragments. This noteworthy book marshals an impressive array of specialists who present structural, metamorphic, paleomagnetic, paleontologic, and stratigraphic evidence on the progressive breakup of the critical northern edge of Gondwana. The authors also discuss the ultimate fate of rifted fragments propelled across Tethys by seafloor spreading.

The first 15 of the 19 papers in the volume address geotectonic (structural and metamorphic processes) and stratigraphic problems (including paleomagnetic data). The remainder deal with paleontological matters from the Paleozoic to the Cenozoic,

particularly as related to paleogeographic issues.

Although somewhat sporadic in its coverage, the collection includes noteworthy contributions. Two papers—by Price *et al.* and Dewey—discuss the plate tectonic mechanisms responsible for the breakup of Pangea and its reassembly into our modern continents. Utilizing stratigraphic evidence and paleogeographic maps, Audley-Charles reviews the evolution of the southern margin of Tethys to show two phases of rifting—one in the mid-Permian, another in the Jurassic. A regional overview paper by Şegnör *et al.* traces the closing of the Paleo-Tethys Ocean and formation of the super-orogenic "Tethysides"—a tectonic complex bridging the whole of Eurasia. Detailed maps and regional integration of magmatic, structural, paleontological, and paleomagnetic data on the Paleo- and Neo-Tethys oceans makes this contribution valuable. Metcalfe discusses the assembly of Southeast Asia, and Tarling covers the evolution of the Indian Ocean. Not all authors agree on how best to interpret the data, and the discrepancies between reconstructions make interesting reading.

Paleontological papers offer exciting data for assessing some of the tectonic postulates presented in the first part of the book. Many are disappointing because of either their lack of detail or the ambiguity of their results. Some are unexpected and frankly controversial, such as Ager's renewed suggestion,

## The Fate of Gondwana

**Gondwana and Tethys.** M. G. AUDLEY-CHARLES and A. HALLAM, Eds. Published for the Geological Society by Oxford University Press, New York, 1988. viii, 317 pp., illus. \$120. Geological Society Special Publications, vol. 37. From a meeting, May 1986.

Geologists visualize the earth 250 million years ago with its continental crust assembled into a single landmass, Pangea. The northern part, Laurasia, was sutured with the southern part, Gondwana, by the late Paleozoic plate collisions. The Tethys Ocean, nestled in the arms of Pangea, bathed the northern shore of Gondwana in warm, tropical to subtropical waters. Stretching eastward from Tethys and occupying most of the globe lay the vast ocean of Panthalassa.

What subsequently occurred was the most extraordinary geologic event to affect the Phanerozoic globe. Tectonic stresses at work in the continental lithosphere of Pangea initiated its breakup, leading to profound changes in Tethys. From the Mesozoic onward, drifting of Gondwana fragments resulted in closure of the original Paleo-Tethys Ocean and the creation of a new body of water, the Neo-Tethys Ocean. Vestiges of this former ocean are found in mountain belts from Gibraltar to Southeast Asia.

Southeast Asia plays a key role in understanding the complex tectonic history of Tethys. It is thought that large blocks of the northeastern edge of Gondwana were rifted



World reconstruction during the early Jurassic, presenting one idea for the origins and subsequent movement (arrows) of lithospheric fragments (patterns) responsible for various closures of Tethys (between Laurasia and Gondwana). T1, T2, and T3 refer to former Tethys oceans. [From J. F. Dewey, "Lithospheric stress, deformation, and tectonic cycles," in *Gondwana and Tethys*]

based on brachiopod distributions, that Turkey was located on the northern side of Tethys during the Mesozoic. Other papers that may elicit healthy debate include those on the opening and closing of marine passages for dispersal of ammonites, deep- or cool-water barriers, dispersal of angiosperms, vanished islands as stepping stones for trans-Pacific spread of Cretaceous bivalves (rudistids), and the dispersal of tetrapod groups across Pangea and among the rapidly assembling fragments of Southeast Asia. Rosen and Smith focus on Cretaceous to Recent reef corals and echinoids. They employ a new cladistic method of parsimony analysis in recognizing endemism and reconstructing biogeographic relationships that holds promise for overcoming prejudices that bias conventional approaches.

This book is a timely and well-produced treatise. The editors have done a commendable job.

GEORGE D. STANLEY, JR.  
*Department of Geology,  
University of Montana,  
Missoula, MT 59812*