and often intemperately to such criticisms, a fact that is also well documented in Minton's biography. But though at first in a minority, these cautionary voices unquestionably contributed to the gradual change of heart of many like Young who had started out as enthusiasts. Today, they represent much of the conventional wisdom about intelligence testing.

*Schools as Sorters* is loaded with illustrations, charts, and tables of statistics. Sometimes such documentation is unnecessary to make the author's points, and one wonders if it has not been included primarily to expand a slim manuscript to a more standard book length. Even without these trappings, Chapman's book would join Minton's in contributing usefully to our understanding of one of the most controversial chapters in the history of American psychology.

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## 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.

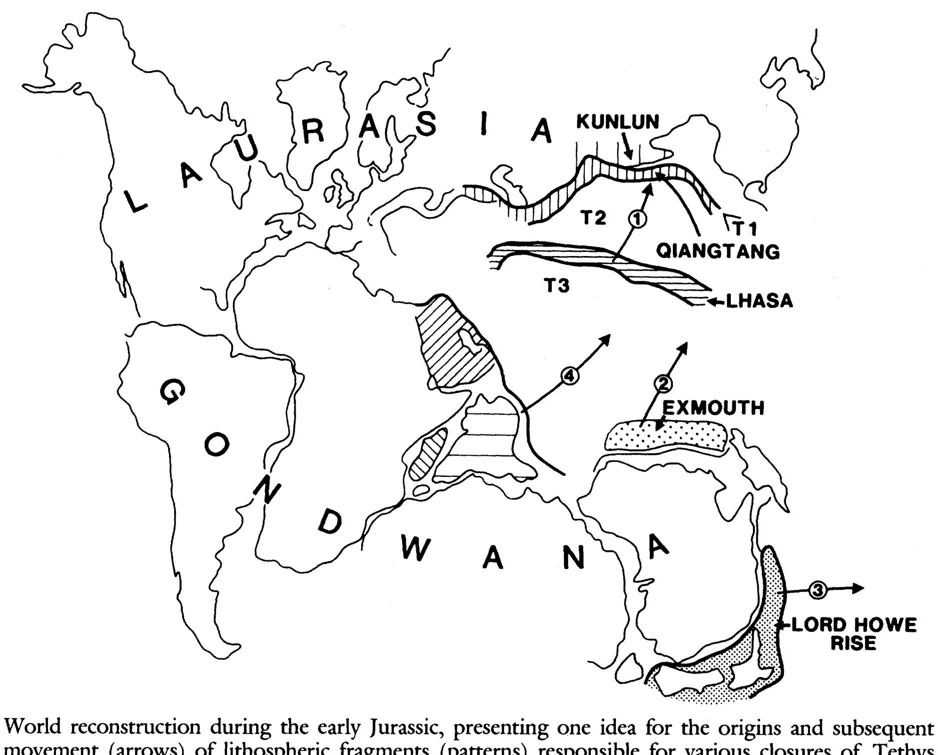
Southeast Asia plays a key role in understanding the complex tectonic history of Tethys. It is thought that large blocks of the northeastern edge of Gondwana were rifted off, then transferred by ocean spreading processes across a substantial part of Tethys, eventually colliding with and becoming attached 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 Şengör *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,




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.

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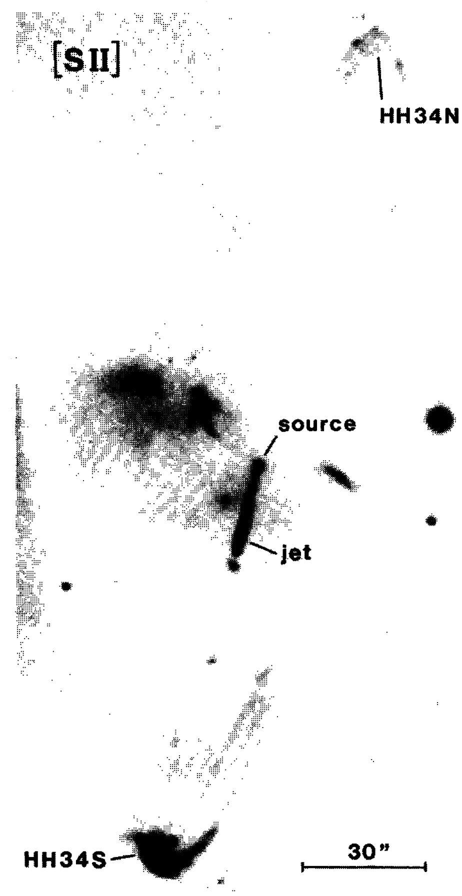
## Stellar Cosmogony

**Formation and Evolution of Low Mass Stars.** A. K. DUPREE and M. T. V. T. LAGO, Eds. Kluwer, Norwell, MA, 1988. xvi, 462 pp., illus. $119. NATO Advanced Science Institutes Series C, vol. 241. From an institute, Viano do Castelo, Portugal, Sept.–Oct. 1987.

Almost two centuries ago, Laplace conjectured that the solar system formed through condensation of a nebula of the sort then being studied by F. W. Herschel. Though Laplace's conjecture turned out to be spectacularly incorrect for nebulae that were later resolved into spiral galaxies, the Laplacian concept of star and planet formation from a rotating, gaseous nebula has survived the centuries and now constitutes the unifying foundation of stellar and planetary system cosmogony. The overwhelming success of the nebular theory is nowhere more apparent than in *Formation and Evolution of Low Mass Stars*, which describes observational and theoretical studies of the origin and earliest evolution of solar-type stars.

[From *Formation and Evolution of Low Mass Stars*]

We now have a generally accepted outline for the formation of low mass stars. The gas and dust in interstellar clouds clump into gravitationally bound, often magnetically supported, dense molecular cloud cores, which undergo self-gravitational collapse and contraction, increasing some 20 orders of magnitude in density. The collapse creates young stellar objects surrounded by envelopes of gas that fall inward and accrete onto the newly formed "protostars" within about a million years. The energy generated by the rapid accretion of the gas results in high luminosities peaking at infrared wavelengths. Strong stellar winds begin to clear away the residual gas and dust, and the protostars emerge from their cocoons as optically visible, pre-main-sequence stars. Continually losing angular momentum through their magnetic winds, these stars contract further and finally reach the long-lived main-sequence phase typified by our sun. All of these phases are covered with considerable expertise in the reviews and other papers in this volume.




The jet from a young star in the constellation Orion. Bow shock structures (HH34N and HH34S), caused by material expelled from the young star, are visible at the top and bottom of the figure as the material interacts with the interstellar medium. Such energetic and bipolar mass flows are an important phase in early evolution for all types of stars. This image was obtained in the light of S II by R. Mundt of the Max-Planck-Institut für Astronomie, Heidelberg-Konigstuhl, at the 3.5-meter telescope of the Calar Alto Observatory in Spain with a semiconductor detector. [From R. Mundt, "Flows and jets from young stars," in *Formation and Evolution of Low Mass Stars*.]

Astronomical observations have already supported nearly all of the basic points of this cosmogonical outline. In particular, observations have provided abundant evidence, both indirect and direct, for the presence of nebular disks around young stellar objects, such as excess infrared emission from the cool portions of the disks, bipolar outflows of molecular gas collimated by nebular structures, receding lobes of bipolar flows that are obscured by the presence of foreground disks, and even interferometric maps of molecular gas rotating in flattened disks about young stellar objects. Undoubtedly Laplace would have been pleased by the accuracy of his once seemingly farfetched conjecture.

The prospects for further refinement of our understanding of stellar cosmogony through future observations look bright indeed; *Formation and Evolution of Low Mass Stars* describes the space telescopes proposed for the near future that will significantly improve our understanding of star formation. The detection and characterization of other planetary systems are another of the great challenges for future observations. For much too long, cosmogonical theorists have had to try to understand planet formation with only our solar system as a model.

Driven in part by the costs of the ambitious ground-based and orbiting telescopes soon to be in operation or proposed for the future and by increasing strength of the European, Japanese, and Soviet programs in astronomy and planetary science, we are now firmly in an era of increasing international collaboration. Considering the already strongly international character of astronomy (demonstrated by the wide and youthful representation of nations at the meeting that gave rise to this volume), future international cooperation in astronomy and planetary science is likely to be extremely fruitful. We in the United States can only hope that our nation continues to cooperate and to support scientific research at a level consistent with our national wealth.

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