locations, along with timed sequences of samples at each vent. Experience in Hawaii shows that this type of study often holds the key to unraveling the processes involved in the overall petrogenetic evolution of the volcano.

Chapter 7, "Internal plumbing," begins by telling the reader how a volcano can be studied through measurement of the ground deformation related to eruptive cycles, using studies at Kilauea as a reference. The principal conclusion is that ground deformation at Etna does not fit the Kilauea model and, specifically, that a shallow storage region is absent beneath the summit of Etna. There is no reference to joint interpretation of petrologic, geodetic, and seismic data to define magma storage and transport paths. Again, Hawaiian experience has shown that these studies need to be tied together to give an adequate picture of the volcanic plumbing. Seismology is sadly neglected here. It would have been useful to have tables summarizing the location, depth range, and frequency of different types of earthquakes associated with volcanic activity.

Chapters 8 and 9 give an excellent account of the history of both volcanic and seismic hazards in the Etna area. Lives have been lost in the area, most recently in 1979; the Etna Volcano Observatory was destroyed in 1971; and significant property loss has occurred during all recent flank eruptions. The most recent large eruption, in 1983, destroyed and threatened property and resulted in a major effort at lava diversion. Chapter 9 is an outstanding summary of volcano hazards from historical, political, and personal perspectives. The enumeration of possible responses to volcanic eruptions, and consequences of those responses, will be useful to readers who live in any active volcanic region.

My main objection to the book is that the authors alternate between a textbook style and a narrative one. For me, the narrative style is the one appropriate to a book about a volcano and its history. Definitions of terms, equations, and geologic principles would be better left to a textbook. The extreme example of this is chapter 5, "The rheological behaviour of basaltic lavas," which seems totally out of place in this book. The chapter mentions Etna as a site where direct measurements of the physical properties of magma have been attempted, but otherwise it is a treatise on rheology that belongs in a book on that subject. The lack of an immediate geographic reference is annoying. (The first index map showing Mount Etna's location is on p. 66 in chapter 3.)

Despite its limitations, I recommend the book for inclusion in all earth science libraries. It provides a comprehensive and useful overview of Mount Etna and is a good starting point for students interested in more detailed treatment of the geology, petrology, and volcanic hazards associated with an active volcano.

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"Well-developed columnar jointing in a thick flow filling a valley at Gole dell'Alcantara at the foot of Etna." The flow followed the river Alcantara to the sea from an eruption at the Moio cone on the northern flank of Etna. Tens of meters thick, it has been exposed by valley downcutting to show the spectacular jointing that has become a tourist attraction. [Photograph by T. J. O. Sanderson; from *Mount Etna*]

Karst

Karst Geomorphology. J. N. JENNINGS. Blackwell, New York, 1985. x, 293 pp., illus. $49.95; paper, $14.95. Second edition of *Karst*.

Karst is a peculiar landscape created in limestone and gypsum by chemical dissolution of the bedrock. Karst landscapes are characterized by closed depressions, deranged surface drainage, and caves. Closed depressions, from small sinkholes to closed basins many kilometers in diameter, collect runoff and divert it to subsurface routes. Tributary streams often sink at the contact with the soluble rocks only to re-emerge great distances away as gigantic springs that may give birth to full-blown rivers. In between there may be only a pock-marked landscape with no surface drainage at all. Caves are fragments of underground solution conduits, and their integrated length may reach many kilometers. Groundwater in karst is also a peculiar thing—a mixture of water stored in pores, rock fractures, and other small openings and water flowing in the pipes and channels of the conduit system where velocities are comparable to those of surface streams.

J. N. Jennings's *Karst Geomorphology* purports to be a second edition of his 1971 volume of similar title. The new book is a complete rewrite of the old. The number of pages is approximately the same, and the subjects covered are the same, but nearly every word of the text has been rewritten and much new material is included. More than half of the figures are new. About two-thirds of the 600-entry bibliography is post-1971, an important consideration because there has been much research over the past decade on the surficial geomorphology and hydrology of karst. The original Jennings book was one of the first works in English on karst, and it served as an important reference for much of the new research.

The book is intended for the advanced undergraduate or beginning graduate student in geology or geography. The strong point of the book is its global view. Jennings has been everywhere and seen everything. His examples of karst phenomena range from West Virginia to Australia to New Guinea to Yugoslavia to his native Yorkshire to Kentucky to the Caribbean to South China to the Malay Archipelago to northern Canada. Every area of the earth where karst occurs seems to be represented by a bit of text or a photograph.

The book is written in the traditional descriptive style of the geomorphologist, which is an unfortunate way to treat a subject in which chemistry plays such a dominant part. The chemistry of carbonate dissolution gets only a couple of pages in spite of the very large and recent literature on both equilibrium reactions and the dissolution kinetics of limestone and dolomite. One searching for the latest detail on chemical processes or the latest work on mathematical modeling and statistical morphometric analysis of karst landforms will find very little of it in this book.

There is a curious mind-set that seems to be common to most karst geomorphologists, who love landforms and caves from exotic locales but don't notice the karst in their own backyards. In the urbanized carbonate terrains of the United States, undermining of highways and foundations by soil piping, sinkhole collapse, reservoirs that refuse to hold water, basement flooding in sinkhole areas, contamination of carbonate

aquifers by hydrocarbons, heavy metals, sewage, and other pollutants, and even the filling of caverns with explosive or toxic gases are the real features of interest. Jennings mentions the importance of this very practical aspect of karst geomorphology in the preface of the book, but he does not discuss it at length on the grounds that a satisfactory exposition would require too much space.

Jennings died of a heart attack while skiing in 1984. This book is his last statement on the subject of karst. It communicates much of his love of landscape and is highly recommended as an introduction to the subject.

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A Reunion in Physics

Shelter Island II. Proceedings of the 1983 Shelter Island Conference on Quantum Field Theory and the Fundamental Problems of Physics. ROMAN JACKIW, NICOLA N. KHURI, STEVEN WEINBERG, and EDWARD WITTEN, Eds. MIT Press, Cambridge, MA, 1985. xii, 369 pp., illus. $37.50.

In early June of 1947, a group of 24 physicists gathered at the Ram's Head Inn on Shelter Island, a remote, sparsely populated island located about 100 miles east of Manhattan near the end of Long Island. Their 2½-day meeting was the first major postwar theoretical physics conference in the United States. Its purpose was to bring together leading researchers to discuss some of the outstanding problems in quantum theory. (The list of participants reads like a Who's Who in Physics.) The impact of that meeting is now part of history. Indeed, as a direct consequence, Hans Bethe produced his famous Lamb-shift calculation and Robert Marshak proposed the two-meson hypothesis. Even more important, the seeds were sown for Richard Feynman's and Julian Schwinger's classic works on quantum electrodynamics and later more formal developments in renormalization theory. Those breakthroughs laid the foundation for our present-day theories of elementary particle physics.

To commemorate that historical meeting, a second Shelter Island Conference was held in June of 1983 at the same Ram's Head Inn. Besides providing a reunion for the class of 1947 (ten of the original 24 participants returned), Shelter Island II was organized in the same spirit as the earlier meeting, to bring together a relatively small group of researchers who would survey the state of elementary particle physics and discuss future directions. Some of the proceedings of that meeting have been edited and collected in *Shelter Island II*.

The first part of the book contains scientific talks by some of the world's leading physicists. It begins with a kind of state-of-theory address by Murray Gell-Mann. As always Gell-Mann is comprehensive and entertaining. (I was particularly amused by his linguistic anecdote that the *f* in O'Raifertaigh, the name of a well-known Irish physicist that I always have trouble spelling, should really be *thbh*.) Gell-Mann provides a nice perspective on how far theoretical physics has advanced and what problems remain. One of those problems—how gravity can be unified with the other fundamental forces—sets the theme for most of the meeting. Subsequent talks range from technical discussions by Steven Weinberg, Michael Duff, and Edward Witten of Kaluza-Klein theories, in which gravity is fundamental and the other forces are a result of compact extra space dimensions, to Stephen Adler's description of gravity as an effect induced by embedding the other fundamental forces in curved space-time. Advances in supersymmetry, an important ingredient in attempts to tame the short-distance infinities of quantum gravity, are discussed by Bruno Zumino and P. C. West. There are also survey talks less (in some cases, not at all) concerned with gravity by T. D. Lee, Roman Jackiw, Alan Guth, A. D. Linde, S. W. Hawking, and Toichiro Kinoshita, who discuss their current research efforts. All of these talks are clear and well written, but I particularly appreciated those on the new inflationary universe cosmology by Guth and Linde, two of the pioneers in that field. However, if Shelter Island II is to have a scientific legacy, I would guess that it might stem from a talk by John Schwarz, "a brief survey of superstring theory." Schwarz and his collaborators have argued for more than a decade that we must abandon our point particle approach to physics at short distances and reformulate theories in terms of string variables. Not long after Shelter Island II, a technical breakthrough by Michael Green and Schwarz led to a viable superstring theory of all interactions found in nature. As a result, during the past two years superstring research has dominated elementary particle theory. Indeed, some superstring enthusiasts have likened the present situation to the exciting early days of quantum mechanics. If this is true, it would make for an interesting Shelter Island III meeting.

Although the scientific proceedings are enjoyable, I prefer the part of the book devoted to historical perspectives. Personal recollections by participants in Shelter Island I make captivating reading. Even more fascinating is a history of Shelter Island I by Silvan Schweber. Schweber chronicles the organization of the meeting, the meeting itself, and subsequent meetings in the Pocono Mountains and Peekskill, New York, at which quantum electrodynamics was reformulated. Schweber's description of a police-escorted bus ride by the conference participants from Manhattan to Shelter Island, dinner hosted by a proud local chamber of commerce, newspaper coverage, and the like combined with a splendid group photograph bring the conference to life and contrast it sharply with today's very different style of conferences. I strongly recommend the section of historical perspectives, particularly Schweber's contribution, to any physicist or student of history. It distinguishes this book from the far too many conference proceedings one regularly receives and earns for it a treasured place in one's permanent library.

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Life in the Universe

The Search for Extraterrestrial Life. Recent Developments. MICHAEL D. PAPAGIANNIS, Ed. Reidel, Dordrecht, 1985 (U.S. distributor, Kluwer, Hingham, MA). xxvi, 579 pp., illus. $64; paper, $29.50. IAU Symposium no. 112. From a symposium, Boston, June 1984.

Three topics in astronomy seem to hold endless fascination for scientists and layfolk: black holes, the origin and structure of the universe, and extraterrestrial life. Of the three, extraterrestrial life is easiest to visualize and even to identify with. Following a considerable period of marginal legitimacy, the search for extraterrestrial life has attained respectability, and the International Astronomical Union recently established a new commission, Bioastronomy, to deal with the subject. The book under review is the proceedings of the commission's first official scientific meeting, held in 1984. The most recent proceedings of previous meetings on