Book Reviews

A Continental Rift

Rio Grande Rift. Northern New Mexico. W. Scott Baldridge, Patricia Wood Dickerson, Robert E. Riecker, and Jiri Zidek, Eds. New Mexico Geological Society, Socorro, 1984. xii, 379 pp., illus. $40; paper, $35. From a conference, Taos, N.M., Oct. 1984.

The annual reports of the New Mexico Geological Society's field conferences, although they contain detailed geological road logs (76 well-illustrated pages in this case), are much more than that, and students of active intercontinental rifting have long known that the papers in these volumes contain much otherwise unavailable information. The 1984 field conference represented a departure from earlier practice in being topical rather than regional. The conference was based in Taos, and the Rio Grande rift in northern New Mexico was the subject. There are contributed papers on nine broad topics: rift processes; tectonics, structure, and geophysics; stratigraphy, sedimentology, and paleontology; volcanic geology; Precambrian geology; economic geology; geomorphology and Quaternary geology; hydrogeology and water geochemistry; and archeology and history. There are full-page color plates showing a Landsat image, gravity and magnetics over the rift, and a tectonic map of the entire rift system.

Studies of continental rifts have progressed rapidly since the development during the last decade of elegant extension models and the widespread dissemination of modern seismic reflection profiles. It is now becoming possible to pose critical questions concerning such subjects as why the rift formed when it did and where it did. Morgan and Golombek in this volume report an evolutionary sequence for the Rio Grande rift suggesting that it was initiated close to (but not exactly over) an area of thin lithosphere associated with the last gasp of Laramide convergent igneous activity in New Mexico. Once initiated, the rift, like others, has developed in a complex way, responding to a variety of external tectonic influences.

Understanding of the complex development of a rift system depends largely on being able to date specific events in the history of the rift accurately. In the Rio Grande rift, as in most continental rift systems such as those of China and East Africa, sediment fill is nonmarine and poorly fossiliferous so that stratigraphic resolution is poor. Papers by Kelley and Duncan and by Manley address this difficulty by using fission track methods. The former have dated the uplift of high ground around the rift by determining the fission track ages of rift fill sediments, and the latter has used fission track methods to date stratiform volcanic rocks within the rift sequence of the Espanola Basin. The stratigraphy of the Albuquerque and San Luis basins has not yet been established with comparable resolution, and this task must represent an outstanding challenge to Rio Grande geologists.

Black reports for the first time on evidence of Laramide thrust faulting beneath the Espanola Basin. Workers in the Great Basin have lately been arguing about the extent to which Neogene extension is accommodated on older thrust planes, and it seems possible that the two processes may have been related in the Rio Grande.

Dungan and others report on the volcanic rocks of the Taos volcanic field. They add to their already published geochemical studies, which indicate the importance of magma mixing in petrologic evolution, by interpreting structural and topographic controls on individual flow distribution. Post-volcanic deformation of lavas erupted between 2,000,000 and 4,000,000 years ago includes faulting, tilting, and compression.

I can think of no comparable detailed structural analysis of a young series of volcanic rocks in a rift. The complexity that has been worked out in the Taos plateau volcanic field suggests to me that we should generally expect structural complexity in rift sediment and volcanic rocks.

Studies of the Rio Grande rift, because of exposure, accessibility, and resources, have long been in the forefront of rift research, and this magnificently produced book is a stimulating successor to earlier publications.

Kevin Burke

Lunar and Planetary Institute, 3303 NASA Road 1, Houston, Texas 77058

Theoretical Physics

Application of Field Theory to Statistical Mechanics. L. Garrido, Ed. Springer-Verlag, New York, 1985. viii, 352 pp. Paper, $23.70. Lecture Notes in Physics, vol. 216. From a conference, Sitges, Barcelona, Spain, June 1984.

The analogy between quantum field theory and statistical mechanics was first developed systematically in the 1950's. With the advent of Euclidean field theory it became possible to put the connection in rigorous mathematical form. By now the two theories are so interlaced that it is hard to find an idea in one subject that has not been used in the other. Both are now in a full flood of development that is likely to last for decades. The book under review constitutes the proceedings of the 1984 Sitges Conference on Statistical Mechanics, and the contributors provide an interesting selection of current research. There are 13 main lectures and 22 shorter communications. Proceedings of this kind give, both to the beginner and to the more experienced in need of refreshment, an entry into current research developments. Typically, the individual contributions sketch main ideas and illustrate them in concrete examples; through their references one can find one's way to the main papers containing the details of experiment and argument. The present volume is an excellent specimen of this type.

Here are some samples of the book's contents. D. Nelson reviews the statistical mechanics of glass. According to his theory, the geometry of the packing of spheres plays a dominant role in the formation of the glassy state; a glass will contain a wild tangle of disclination lines formed in response to geometrical constraints. In addition to glasses, there are spin glasses, here considered in two contributions, one by C. de Dominicis and one by de Dominicis and I. Kondor. The theory of these substances has been one of the most active subjects in statistical mechanics in the last few years, and the theory that has resulted is marked by great ingenuity.

There are three contributions on surface effects. E. Brézin reports on recent work on the wetting transition. As he makes clear, it is not obvious that the elegant theory he develops will be applicable to experiment, because it assumes the absence of significant long-range forces, but if the day arrives the theory is ready. H. Wagner contributes an account of surface effects in second-order phase transitions. Here the problem is to

give a consistent treatment of both bulk and surface properties at the same time. The singularities corresponding to bulk phase transitions appear in both the bulk and the surface free energies, but the surface free energy has singularities of its own in addition, corresponding to surface phase transitions.

In a contribution on rigorous studies of critical behavior, M. Aizenman announces results that show that in a large class of models there is a unique critical temperature above which correlations decay exponentially and below which there is a positive spontaneous magnetization. This was an expected result, but the problem of proving it from first principles had been open for a long time. In addition to reviewing other recently obtained rigorous results, Aizenman outlines a treatment of the intersection of Brownian paths that enables one to put the discussion of the well-known β function on a rigorous footing.

J. Fröhlich surveys the statistical mechanics of random surfaces and its application in condensed matter physics and quantum field theory. This is a rich and subtle subject that appears to be fundamental in a number of important physical problems. One has only to mention a few key phrases to evoke the wealth of phenomena in the subject: surface roughening, topological complexity, crumpling, collapse to treelike surfaces.

I hope this review has made clear that the book describes many exciting results in theoretical physics and an even larger number of opportunities for future work.

A. S. WIGHTMAN
Department of Physics,
Princeton University,
Princeton, New Jersey 08540

Nociceptive Transmission

The Pain System. The Neural Basis of Nociceptive Transmission in the Mammalian Nervous System. W. D. WILLIS, JR. Karger, Basel, 1985. x, 346 pp., illus. $86.25. Pain and Headache, vol. 8.

In the two decades since the publication in this journal of Melzack and Wall's classic article, "Pain mechanisms: a new theory," there has been an explosion in our understanding of the mechanisms of pain perception. However, despite the publication of numerous books and reviews on the subject, there has been no concise contemporary report published that contains enough detail and accuracy to inform workers in the field while retaining the perspective, structure, and coherence to be accessible to those outside the field. Willis has succeeded in producing such a volume.

Though its coverage is broad, the work is not so much a detailed compendium as it is a readable summary of research on transmission of the nociceptive message, from the obscure transduction event in somatic tissue through complex peripheral and central neural networks to an even more obscure perceptual event. On the way, a wealth of anatomical and physiological detail is described, beginning with the extensively studied nociceptive primary afferents and ending with recent work characterizing nociceptive cortical neurons. One comes away from this fairly brief, profusely illustrated book with the feeling that one has the basic story under one's belt and enough recent key references to gain access to an extensive literature.

Of particular interest are the descriptions of recent experiments recording from single nociceptors and stimulating small bundles of fibers to produce sensation in awake humans. There are also excellent reviews of the anatomy of the superficial layers of the spinal dorsal horn and of the anatomy and physiology of thalamic and cortical areas that respond to nociceptive stimuli. Most of this material is new, and the treatment of it is both complete and concise. Not surprisingly there is extensive coverage of the spinothalamic tract, Willis's major research interest.

Willis tends not to dwell on theory in this book. He has been parsimonious with his own interpretations, preferring to state the observations and let the reader draw his or her own conclusions. Although some of the previous theories of pain sensation are mentioned (those based on specificity, pattern, gate control, and diffuse noxious inhibitory control) they are only briefly described.

The book is profusely illustrated; however, most of the illustrations are borrowed directly from previously published work. On balance this is fine, but it leads to a lack of uniformity, captions in which many symbols are unexplained, and figures that are occasionally confusing.

The book is primarily focused on basic anatomy and physiology. It contains only the briefest coverage of an extensive literature in pharmacology and immunocytochemistry. Interesting and important clinical observations concerning pain following peripheral or central nervous system injury are not mentioned. Although these subjects are important, omitting them helps to preserve the cohesiveness of the book and thus its accessibility to neuroscientists not familiar with pain research.

One important subject that the book does not cover is the descending control of nociceptive transmission, which Willis has dealt with in another recent book (*Control of Nociceptive Transmission in the Spinal Cord*, Springer-Verlag, 1982).

Despite these omissions (or perhaps because of them) this is a cohesive, timely, and well-written book that should be on the shelf for quick reference by all clinicians and neuroscientists interested in pain.

HOWARD L. FIELDS
Departments of Neurology and Physiology, University of California, San Francisco 94143

A Reef System

Corals and Coral Reefs of the Galápagos Islands. PETER W. GLYNN and GERARD M. WELLINGTON. With an annotated list of the scleractinian corals by John W. Wells. University of California Press, Berkeley, 1984. xvi, 330 pp., illus. $45.

The 19th-century natural historians who described coral reefs often did so on the basis of observations of the many reefs they encountered during lengthy scientific expeditions. In contrast, present-day studies of coral reefs have tended to center on a relatively few, easily accessible localities. This has the advantage of providing detailed documentation for a few reefs but entails the risk that these few may become generally perceived as "typical." For this reason, descriptions of previously unstudied reef systems are valuable.

Despite the region's history as a site for biological discovery, the reefs of the Galápagos Islands have remained largely unexplored and undescribed. Yet several accidents of geography combine to make the Galápagos an unusual and particularly interesting location for studying reef corals. The archipelago is an isolated oceanic outpost, and, owing to the prevailing westerly moving currents, its biogeographical affinity is with the faunally depauperate reefs of Central and South America. In places, seawater temperatures seasonally approach the lower limits for the growth of reef-building corals, creating a marginal habitat for reef development. Finally, the convergence of several major currents on the Galápagos results in pronounced regional differ-