Book Reviews

A Voluminous Eruption

The Great Tolbachik Fissure Eruption. Geological and Geophysical Data 1975–1976. S. A. FEDOTOV and YE. K. MARKHININ, Eds. Cambridge University Press, New York, 1983. xii, 341 pp., illus. $69.95. Cambridge Earth Science Series. Translated from the Russian edition (Moscow, 1978) by the Cambridge Arctic Shelf Programme translation team.

The most voluminous eruption of basaltic lava and tephra since the 1783–84 eruption of Lakagigar, Iceland, took place in Kamchatka, U.S.S.R., between 6 July 1975 and 10 December 1976. About 2 cubic kilometers of material (more than four times the volume of the largest historic eruption of Mauna Loa) were erupted from two major vent areas in the Tolbachik regional zone of cinder cones, a fissure system extending more than 38 kilometers south-southwest of Ploskiy Tolbachik volcano. The initial activity—from the northern breakthrough about 17.5 kilometers south of Ploskiy Tolbachik, which itself had been erupting tephra mildly since 28 June—was correctly predicted several days in advance on the basis of seismic studies. The prediction enabled the early establishment of monitoring networks that formed the nucleus for intensive geologic, geodetic, and geochemical studies conducted throughout the eruption. Activity at the northern breakthrough was unusually violent for a basaltic eruption, generating a tephra-laden column 8 to 13 kilometers high that persisted throughout the development of three large cinder cones as well as voluminous flows. This activity continued until mid-September 1975, when the locus of eruption shifted about 12 kilometers southward to the southern breakthrough, where it continued until the end of the eruption. The shift was preceded by collapse of the summit of Ploskiy Tolbachik, a month-long event culminating in the second half of August with a caldera 1.7 kilometers in diameter, 0.5 kilometer in depth, and 0.3 cubic kilometer in volume. This is less than half the volume of the later eruption products, so that even if all the magma withdrawn from Ploskiy Tolbachik had been erupted additional magma either stored within the fissure system or supplied from depth was involved. Most of the lava erupted from the northern breakthrough is relatively mafic basalt, and most from the southern breakthrough is relatively alkaline high-alumina basalt. Small volumes of lava of intermediate compositions were erupted just before and just after the shift in vent locations and are interpreted to reflect mixing of relatively mafic magma supplied from depths of perhaps 30 kilometers with relatively alkalic magma withdrawn from Ploskiy Tolbachik. This interpretation is supported by seismic data, which show focal depths of as much as 30 kilometers before the eruption from the northern breakthrough and generally less than 5 kilometers before the activity in the southern breakthrough. In addition, earthquakes were distributed between Ploskiy Tolbachik and the site of the southern breakthrough during the shift in vent locations, seemingly tracing the lateral movement of magma. The general similarity of this behavior to that of Kilauea is remarkable, especially when the vastly different tectonic settings—above a subduction zone for Ploskiy Tolbachik and in the interior of a plate for Kilauea—are considered.

As a consequence of cold war politics, the Kamchatka volcanic area is closed to Western scientists. Most of us who cannot read Russian or who have not spoken directly with Soviet colleagues know little about this remarkable eruption. No book can take the place of direct field observations, but the one under review goes a long way toward making the great Tolbachik fissure eruption an integral part of Western volcanologic literature. The book consists of 25 separate papers dealing with many different aspects of the eruption, from the regional geologic setting to chronologies of many events to detailed analyses of volcanic tremor and gases. An additional paper traces the development of the Kamchatka Volcanological Station, one of the leading volcano observatories in the world. The collection of papers gives a comprehensive overview of the eruption, although the absence of a large-scale map showing all place names makes some sections hard to follow (page-size maps are abundant). I think that a necessary complement to the book is the 1976 paper by Fedotov, Khrenov, and Chirkov (*Dok. Acad. Sci. USSR, Earth Sci. Sect.* **228** 1193), which traces the course of events at the northern breakthrough much more thoroughly than is done in the book. The book is well illustrated, particularly with regard to line drawings, and the translation is adequate, although synonyms or even approximations are used for some technical terms used only by specialists. Inevitably, *The Great Tolbachik Fissure Eruption* will be compared with the U.S. Geological Survey's Professional Paper 1250, which deals with the eruption of Mount St. Helens. Both provide a wealth of information about an important volcanic event, have broad but somewhat uneven coverage, contain differences of opinion (perhaps less obvious in the Tolbachik book), and should be owned by every volcanologist.

DONALD A. SWANSON
Cascades Volcano Observatory, U.S. Geological Survey, Vancouver, Washington 98661

Quantum Biology

Structure and Dynamics. Nucleic Acids and Proteins. ENRICO CLEMENTI and RAMASWAMY H. SARMA, Eds. Adenine Press, Guilderland, N.Y., 1983. xii, 488 pp., illus. $49. From a symposium, La Jolla, Calif., Sept. 1982.

This collection of papers from a meeting of the International Society of Quantum Biology attempts to bring together theory and experiment in elucidating the nature of structure and dynamics in biopolymers. Some authors also try to reconcile experimental results with theoretical calculations designed to illuminate the origin of the experimental phenomena. Although not all aspects of the subject are covered in the volume, several interesting topics are discussed.

The editors have ordered the papers so that the subject is developed more logically than in most proceedings. Conceptual and didactic material is included as well as the latest calculations and experimental results.

The book is divided into three parts. In the first part the physical bases (often couched in mathematical terms) of molecular structure and dynamics are developed; in the second part the structure and dynamics of nucleic acids are explored experimentally and theoretically, with an emphasis on theory; and in the third part the structure and dynamics of proteins are examined theoretically and experimentally.

The subject of solitons in proteins and nucleic acids is rather thoroughly discussed by proponents of the notion, with seven of the 29 papers in the volume devoted to the subject. I use the popular term "soliton" to encompass the broader phenomenon of nonlinear dynamics and solitary waves. A paper by D. W. McLaughlin gives an excellent introduction to solitons and describes the properties that a soliton must possess if it is to exist in any particular system. J. A. Krumhansl and D. M. Alexander lucidly continue the development of the subject and demonstrate how the theory can be applied to macromolecules, namely double-stranded nucleic acids. H. M. Sobell *et al.* go on to use these ideas in postulating mechanisms for some dynamic processes entailing nucleic acids.

The major problem with the idea that there are solitons in biopolymers is that no one has presented an experiment that would definitively prove that they exist. A. C. Scott has addressed this problem in the case of proteins at least to the extent of making a connection with quantitative experimental results. Specifically, published laser-Raman scattering results below 200 cm^{-1} from *Escherichia coli* K-12 cells are considered. Some of the spectral lines are ascribed to internal vibrations of alpha-helix solitons. However, there are so many lines in the spectrum, the majority of which are not attributed to solitons, that the evidence is weak. Furthermore, no attempt was made to rule out other potential sources of the lines.

A group of papers scattered throughout the volume explores the "breathing" motions of nucleic acids and protein. Breathing motions are the putative causes of observed hydrogen exchange experiments. Experimental studies of proteins are described in a paper by S. W. Englander and J. J. Englander on hemoglobin and one by C. M. Dobson on lysozyme. The paper by the Englanders discusses selective tritium labeling of a protein at functional sites as a means of investigating the validity and nature of local unfolding models. In a nice bit of work, P. A. Mirau and D. R. Kearns obtained the imino hydrogen exchange rates and activation energies for a series of DNA double helices using proton nuclear magnetic resonance relaxation measurements. The results permit some generalizations regarding the effect of sequence and conformation on the exchange process. G. S. Manning has developed an interesting model relating bending and breathing motions in DNA. In this model, the breathing motion of a single base pair predisposes the double helix to bend or kink at that point. It is demonstrated that the model is consistent with experimental results.

Among papers in this volume to be commended is an excellent presentation by R. E. Dickerson, M. L. Kopka, and H. R. Drew, who introduce concepts to be considered in searching for generalities of sequence-dependent DNA conformation and dynamics. Available x-ray crystallography results are examined to obtain some structural rules.

THOMAS L. JAMES
Department of Pharmaceutical Chemistry, University of California, San Francisco 94143

Pioneering Computers

Reckoners. The Prehistory of the Digital Computer, from Relays to the Stored Program Concept, 1935–1945. PAUL E. CERUZZI. Greenwood, Westport, Conn., 1983. x, 182 pp., illus. $29.95. Contributions to the Study of Computer Science, no. 1.

Acting on the premise that if we know where we've been we can have a sharper perception of where we're going, the author examines in this partly technical, partly historical account four pioneering contributions to computer technology: the electromechanical computers of Konrad Zuse in Germany, that of Howard Aiken at Harvard (the Mark I), the relay computers of George Stibitz at the Bell Telephone Laboratories, and the electronic ENIAC of John Mauchly and J. Presper Eckert at the University of Pennsylvania.

The physical characteristics and the independent historical antecedents of each are presented. For each of the four, Ceruzzi describes the hardware components and how they worked; the keyboard and display (input and output) facilities; the ways in which each set up physical analogs of arithmetic quantities and "calculated" with them; the reliability and internal-checking features; the programming techniques employed; the peculiar research and development problems encountered and solved; and the special uses to which each computer was put.

Readers already knowledgeable concerning the machinery and internal functioning of computers will find satisfying details on these prototypes. Those unfamiliar with how computers can carry out typical basic chores or how basic computer-design problems may be met will find lucid introduction and explanation, supplemented by helpful glossaries, an appendix, and historically valuable chapter-end notes and bibliography.

The author's four examples present scientific creativity and mechanical invention as both personal and social phenomena, chancy and unpredictable in their occurrence and in their consequences. "The key concepts of computing were discovered independently in different places by different persons," Ceruzzi notes when reviewing Zuse's achievements (p. 40). Aiken's contribution to the mainstream of computer design progress was "an impressive first step" that had no consequences after 1950 (p. 69). AT&T was involved in computer technology from the beginning, yet it "stands outside the direct ancestral line that leads to the modern computer" (p. 101). The ENIAC machine, for all its importance as the first electronic digital computer, "never strayed far from numerical integration of differential equations" (p. 128), but the speed, power, and promise of its operation confirmed growing enthusiasm about the future of this new programmable machine.

Because Ceruzzi's major interest is historical, he subordinates the description of hardware and programs to the task of explaining how certain strategic creative efforts undertaken by inventors set the stage for the "computer revolution." In particular, he suggests (chapter 6) that toward the end of that first decade ideas of reckoning—that is, theory—provoked by the hardware became more important than the machines themselves and moved to the center of historical action as a consequence of the invention of the stored program. Turing in a paper of 1936 had already seen the advantage of the stored program that mixed data and instructions without confounding the operation of the machine. But, Ceruzzi argues, it was not until design discussions involving Eckert, Mauchly, and von Neumann stimulated von Neumann to issue his famous "First Draft of a Report on the EDVAC" in 1945 that "an understanding of the true nature of computing emerged" (p. 132).

This notion provides an appealing romantic climax to the decade: von Neumann—who "broke with Eckert and Mauchly," we are told softly (p. 139)—plays the genius hero, and Zuse stands in the wings as a backup with his *Plankalkul*, waiting for history to recognize him.

But Ceruzzi has so effectively presented the case that "it was against the background of those early machines that the theory first took form" (p. 147) that the thoughtful reader may well wonder what else was going on and whether