Book Reviews

Elementary Particle Physics

Probing Hadrons with Leptons. Proceedings of a seminar, Erice, Italy, Mar. 1979. GIULIANO PREPARATA and JEAN-JACQUES AUBERT, Eds. Plenum, New York, 1980. x, 508 pp., illus. $59.50. Ettore Majorana International Sciences Series, Physical Sciences, vol. 5.

In the decade 1970–1980 there occurred a number of significant advances in our understanding of elementary particle physics. Important steps were taken in the development of a unifying gauge theory of the weak and electromagnetic interactions of elementary particles through an exciting concurrence of experimental and theoretical accomplishments. Simultaneously, a new view of the nature of hadrons and their strong interactions evolved from its birth as an extraordinarily prescient conjecture to maturity as a quantitative theory (albeit with certain basic difficulties) supported by a substantial body of experimental data. New degrees of freedom of hadronic matter indicative of hadronic substructures, that is, of hadron constituents, were found experimentally and incorporated naturally, first, in the elegant and simple quark-parton model and, later, in a more ambitious relativistic quantum theory of hadrons (quantum chromodynamics). Consolidation of these advances continues, and, in addition, the success they represent has stimulated serious attempts to formulate a theory that would unify the strong as well as the weak and electromagnetic forces, which is one of the newer concerns of present elementary particle physics.

In this volume many of these developments are described in a series of papers by experts in their respective fields. The papers cover much of the experimental effort of the past few years: e^+e^- colliding-beam experiments and lepton-hadron scattering experiments. They look forward in time, for example, indicating from the early results on e^+e^- scattering at 13- and 17-GeV center of mass energies at Petra the prospects at higher energies and luminosities (Böhm) and discussing the plans for lepton physics with the future 1000-GeV accelerator (Tevatron) at Fermilab (Kirk). They look backward in time to relatively low q^2 electroproduction experiments (Osborne), to early muon-scattering results at high q^2 (Anderson and Chen), and to data on neutrino-induced weak neutral currents (Haidt). In addition, new results on second-generation, that is, current, muon-scattering experiments from Fermilab (Strovink) and CERN (Stier, Aubert, and Smadja) are presented, as well as descriptions of the experimental apparatus employed in those experiments.

There are seven theoretical papers, in five of which the central issues are the properties of quantum chromodynamics (West) and the applicability of quantum chromodynamics to the description of the final states of e^+e^- interactions (Gaillard) and of lepton-induced reactions (Landshoff, Binétruy and Girardi, and Reya). A less sanguine view of quantum chromodynamics that includes an alternative program is put forth in the concluding paper of the volume (Preparata).

Much of the material here will appear in professional journals in papers of more limited focus and with greater detail. The principal virtues of the volume are its timeliness, its concentration on a single (but broad) subject, and the less formal and general nature of most of the papers. These advantages will make it of value to the researcher and to the advanced student alike. The clarity of the layout and of the printing further enhances its value.

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Igneous Petrology

Physics of Magmatic Processes. Papers from a conference, 1977. R. B. HARGREAVES, Ed. Princeton University Press, Princeton, N.J., 1980. x, 586 pp., illus. Cloth, $40; paper, $15.

Physics of Magmatic Processes is the second recent volume of papers honoring the great contribution to igneous petrology made by Norman L. Bowen. The earlier volume, *The Evolution of the Igneous Rocks: Fiftieth Anniversary Perspectives*, edited by H. S. Yoder, summarized modern advances in all the subjects treated by Bowen in his 1928 book, *The Evolution of the Igneous Rocks*, chapter by chapter. The present volume differs in that it contains discussions of ideas about the behavior of magma that have been developed largely since Bowen's time. Many of these ideas, however, were anticipated by Bowen in his concluding chapter, "Petrogenesis and the physics of the earth."

Bowen realized that petrogenesis of igneous rocks could not be studied independently of the contributions of geophysics. Unfortunately the relationship is often neglected today, and recent literature reflects the fact that geophysicists and geochemists consult with one another all too infrequently about limitations on magma genesis. The contributors to this volume partially bridge the gap by recognizing that, whereas the production of partial melts may be controlled by pressure, temperature, and volatile contents, their realization as magma bodies to be erupted or stored in the earth depends on physical factors—namely the contrasting rheologies of the melt and the enclosing solid mantle and crust separating the source region from the surface of the earth.

The scope of this volume is large. Several papers are devoted to the rheology of magmas, including density and viscosity of magmas at high pressure (I. Kushiro) and the mechanics of magma accumulation and transport during and following partial melting (H. R. Shaw; F. J. Spera). Other papers consider properties of melts, including the kinetics of nucleation and subsequent crystallization (E. Dowty; G. Lofgren) and the related subjects of melt structure (P. C. Hess) and chemical diffusion (A. W. Hofmann). The volume contains one paper on the geophysics of heat flow and magma genesis (E. R. Oxburgh), one on the thermodynamics of the albite-anorthite-diopside system (D. F. Weill, R. Hon, and A. Navrotsky), and one on trace element and isotopic limitations on magma genesis (S. R. Hart and C. J. Allègre). (Unhappily, the volume does not contain a comparable treatment of major-oxide mass balances of magmas and mantle source materials.) Finally, there is an excellent paper on processes that accompany cooling and crystallization of large mafic magma chambers (T. N. Irvine).

Some notable omissions decrease the usefulness of the volume as a modern reference on the physics of magmatic processes. There is, for example, no account of H. S. Waff's experimental studies of the wetting properties of partial melts at high pressure or of studies of chemical diffusion and crystal fractionation in silicic magma systems, as represented by the work of W. Hildreth and