Perturbation Theory and Waves

Atmospheric Waves. TOM BEER. Halsted (Wiley), New York, 1974. xvi, 300 pp., illus. $47.50.

From the point of view of a dynamics-oriented physicist, everything moving behaves in the manner of waves, even in the quiet state where the frequency is zero. If it is furthermore allowed that the waves can be linearly superimposed, then the general solution for any wave is simply composed of Fourier components. Of course, in the case of atmospheric waves this is possible only if perturbation theory is used. Exactly this is done in Beer's book. It is surprising how broadly perturbation theory is applicable for the interpretation of measurements even though the observed waves, particularly within the upper atmosphere, may have rather large amplitudes.

Beer systematically discusses the various harmonic perturbation waves that are thought to exist within the lower and the upper atmosphere. These are the plane short-period internal and external acoustic-gravity waves, including Lamb and boundary waves, as well as the spherical long-period planetary waves such as tides and Rossby and Kelvin waves. Concise chapters introduce the reader to the elements of atmospheric turbulence, viscosity, heat conduction, barotopic and baroclinic instabilities, and ducting, coupling, and reflection of the waves. The book is, however, concerned primarily with waves within the nondissipative atmosphere. The excitation of these waves is treated only qualitatively (except for tidal waves), although several good approaches to that subject exist in the literature. This is a pity, because the mechanism of wave generation is likely to be studied more extensively in the near future.

One chapter deals with wavelike structures within the thermosphere, but only the interaction between gravity waves and the ionospheric plasma is discussed in detail. The reviewer would have liked to read more about waves of planetary scale at thermospheric heights. In general, however, the book is a well-balanced compromise between a textbook and a monograph. One can follow the mathematics immediately. Occasionally the author chooses to present only the results of calculations, but the up-to-date literature list assists the reader in proceeding further.

There are a few misprints and some small errors in the physical interpretation, which do not, however, seriously diminish the value of the book. *Atmospheric Waves* fills a gap, since it collects and treats consistently results scattered through the literature of such apparently diverse fields as meteorology and upper atmospheric physics. The author's writing style is light and lively, and the composition and format of the book are excellent.

H. VOLLAND
Institute of Radioastronomy, University of Bonn, Bonn, West Germany

The Actinide Group

The Actinides. Electronic Structure and Related Properties. A. J. FREEMAN and J. B. DARBY, Eds. Academic Press, New York, 1974. Two volumes. Vol. 1. xxii, 360 pp., illus. $36. Vol. 2. xiv, 386 pp., illus. $36.50. Materials Science and Technology.

The purpose of these two volumes is to review the electronic structure of the actinide elements, alloys, and compounds in a comprehensive fashion. The articles generally are well written, they appear to cover the literature fairly completely through 1972, and the editors have done an excellent job in coordinating the topics covered by the reviews. This task was probably made easier because the great majority of the authors are associated with Argonne National Laboratory.

Of the 14 articles contained in these volumes, more than two-thirds are primarily reviews of experimental results. The theme of most of the reviews is the experimental technique that is used to obtain the data, including discussions of bulk magnetic measurements, magnetic resonance techniques, Mössbauer and angular correlation, neutron scattering, transport property measurements, ultrasonic methods, and optical techniques. The review on optical techniques—which includes optical absorption, photoemission, and soft x-ray spectroscopy—is somewhat different from the other reviews in that very few data are available and it emphasizes the information that could be obtained by the application of some of these relatively new techniques.

The actinide materials that are the primary subjects of these reviews are the metals, alloys, and compounds that are either semiconductors or good metallic conductors. Examples of such compounds are the hydrides, carbides, pnictides, and chalcogenides. Possibly 90 percent or more of the measurements reported have been made on materials that contain thorium, uranium, neptunium, or plutonium. This fact points up one of the main difficulties in dealing with the actinide series: only a limited number of the elements are readily available. The transplutonium materials are highly radioactive, only small quantities can be readily utilized, and the purity and quality of the samples must be carefully considered in the interpretation of the measurements.

The theoretical articles that describe crystal field theory, band structure calculations of the metals and compounds, and many-electron effects are especially illuminating. The main concern is with determining the proper theoretical model to describe the role of the $5f$ electrons, which show itinerant or nonlocalized behavior in the early part of the actinide series and localized behavior in the transplutonium materials. This unique behavior of the $5f$ electrons in the early actinides is the source of the difficulties encountered in theoretical treatments and the challenge to such treatments. Although many experimental data have been collected, the theoretical development necessary to understand and unify this body of work has only recently begun. These articles lucidly review the current state of this development and suggest directions for future efforts.

This book accomplishes its purpose. It critically summarizes the state of knowledge in the field and should stimulate further efforts toward a fuller understanding of the behavior of the actinides.

GLENN T. SEABORG
Lawrence Berkeley Laboratory, University of California, Berkeley

High Energy Physics

Phenomenology of Particles at High Energies. Proceedings of the 14th Scottish Universities summer school (a NATO Advanced Study Institute), Edinburgh, 1973. R. L. CRAWFORD and R. JENNINGS, Eds. Academic Press, New York, 1974. xii, 744 pp., illus. $47.25.

Proceedings of summer schools are often of ephemeral value, and badly printed to boot. The Scottish Universities summer schools have traditionally resulted in readable volumes of lasting interest, and this one is no exception.

The major portion of the volume is devoted to multiple hadron production in ultrahigh-energy proton-proton collisions. This emphasis is due to the completion of the intersecting storage rings (ISR) at CERN. This facility has provided European physicists with copious data at energies equivalent to a laboratory momentum of up to 2000 Gev/c.

The book contains several articles on hadronic processes that should be understandable to nonspecialists. J. C. Sens provides a detailed description of the ISR, of various experiments that utilize it, and of

the resulting data. An introductory survey of the theory underlying these processes is given with characteristic lucidity by J. D. Jackson. There is also an unexpected gem: a paper on multiple production by K. G. Wilson, written and circulated privately in 1970 and never published before, even though it has had a significant impact on the field. Despite its originality, this contribution is almost free of formulas and can be read by any physicist. A rather more technical, but nevertheless very accessible, description of hadronic interactions by H. Harari also appears here.

Of the remaining lectures, there are two of broad interest. That by P. W. Higgs draws several illuminating analogies between symmetry breaking in relativistic field theories and systems studied in statistical physics, such as superfluids and plasmas. C. H. Llewellyn-Smith describes the seminal attempts, initiated by Weinberg and Salam, to unify the weak and electromagnetic interactions. In Llewellyn-Smith's approach the symmetry properties of the fields are deduced as a consequence of the requirement that the theory be renormalizable. The experimental consequences of these models are also discussed, but here there have been very important developments since the summer of 1973.

KURT GOTTFRIED
Laboratory of Nuclear Studies,
Cornell University,
Ithaca, New York

Quantum Mechanics

Orbital Theories of Molecules and Solids. N. H. MARCH, Ed. Clarendon (Oxford University Press), New York, 1974. xvi, 386 pp., illus. $29.50.

Charles Coulson was an applied mathematician, theoretical solid state physicist, and theoretical chemist whose hallmark was clarity of thought and presentation. A group of his friends and former students have put together in his honor this book on the quantum mechanics of electronic energy levels. The chapters on solids deal with band theory, the cellular method, one-body potentials in crystals, and defects in crystalline solids. The chapters on molecules deal with properties of both isolated and interacting molecules. The editor has wisely excluded discussions of isolated atoms and has eschewed the alphabet soup of ab initio molecular calculations.

Each chapter reads like a colloquium lecture. The authors begin with the foundations of their subjects and only later present the details. Most chapters contain judicious evaluations of the relative importance of different developments in the field. This kind of insight is seldom available in the original theoretical literature.

Although suitable as a textbook only for a rather advanced student, this is a book from which one can learn. This reviewer, who is not a solid state theorist, finished Altmann's chapter on the cellular method for metals with a much improved understanding of this often criticized method. The same is true for the chapter by Balint-Kurti and Karplus on the atoms-in-molecules method, which has been improved considerably over its original formulation. McWeeny's chapter on molecular properties is characteristically elegant; it contains a most satisfying explanation of the Jahn-Teller effect. Perhaps the most comprehensive chapter is the one on defects in crystalline solids by Lidiard, who manages in 75 pages to discuss qualitatively the properties of all the principal localized defects and to give for each one an outline of the theory or at least useful references.

These chapters were written while Coulson was still alive. Gentle as he was, Coulson would have asked embarrassing questions about vague or disorganized presentations, and every author seems to have tried especially hard to achieve clarity and coherence with the other authors. *Orbital Theories of Molecules and Solids* is strongly recommended to anyone interested in the subject.

RICHARD BERSOHN
Department of Chemistry,
Columbia University,
New York City

Virology

Viruses, Evolution and Cancer. Basic Considerations. Proceedings of a conference, Montreal, Aug. 1973. EDOUARD KURSTAK and KARL MARAMOROSCH, Eds. Academic Press, New York, 1974. xxxii, 814 pp., illus. $48.50.

Excitement in particular fields of science is almost invariably reflected in the number of symposiums, conferences, and congresses dealing with those fields. There have been countless meetings dealing with viruses in recent years, and, judging by the proceedings, the Second International Conference on Comparative Virology was an enormous success. The book is over 800 pages long. Its 28 chapters are arranged in seven sections entitled, not always appropriately, Host-Cell-Virus Relationships, DNA Transfer and Virus-Cell Relationships, Comparative Aspects of DNA Oncogenic Viruses, Comparative Aspects of RNA Oncogenic Viruses, Viruses, Cell Surface, and Transformation, Comparative Viral Oncology, Comparative Immunology of Oncogenic Viruses, and Viruses and Their Evolution.

Several aspects of the book stand out. Nearly half of the chapters, and many of the better ones, are multiauthored, undoubtedly reflecting the technical complexity of modern virology. Along with established investigators who perform at nearly every conference, there are recent entrants. I found the chapter by J. L. Melnick, A. L. Boyd, and J. S. Butel on the DNA transfer experiments not only well written but also very interesting; the acquisition of affinity to poliovirus by hamster cells following transfer of DNA from monkey cells is an interesting finding with numerous potential applications. I was pleased to see a well-reasoned, cautious chapter by J. S. Pagano on Epstein-Barr virus and its interaction with human lymphoblastoid cells and chromosomes. Considering the many assertions concerning the role of Epstein-Barr virus in the causation of human malignancy made in the recent past, the objectivity of this chapter is refreshing. A clearly written chapter by R. Sheinin on cell surface virus modification and virus transformation makes up for its brevity by its very scholarly review of the literature. R. Weil *et al.* ably defend the view that papovaviruses are capable of acting as endogenous mitogens and that malignant transformation is a secondary phenomenon. Other notable chapters are by L. Prevec on physiological properties of vesicular stomatitis virus and some related rhabdoviruses, by T. O. Diener on viroids, by D. Solter, W. Biczysko, and H. Koprowski on host-virus relationship at the embryonic level, by M. R. Hilleman on prospects for vaccines against cancer, and by H. S. Ginsberg *et al.* on adenovirus genes and cancer.

The strength of the book is the juxtaposition of animal and plant viruses in the context of properties, gene expression, and evolution; and even here the coverage of bacterial phages could have been expanded beyond the one chapter by W. and E. Szybalski. Its weakness results chiefly from the attempt of the organizing committee to maximize international representation; as a consequence the book conveys little of the current excitement in the molecular biology of papova and oncornaviruses. Many chapters, but notably those on herpesviruses, convey a strong feeling of *déjà vu*. I was disappointed by the printing of halftone illustrations; the electron micrographs of replicating DNA molecules in