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.

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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.

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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