Book Reviews

Effects of Weak Interactions

Beta Decay and Muon Capture. MASATO MORITA. Benjamin/Addison-Wesley, Reading, Mass., 1973. xii, 362 pp., illus. $19.50.

The study of beta decay has been pursued for nearly 80 years. However, until the late 1950's most properties of the weak interaction—one of the four fundamental interactions (strong, electromagnetic, weak, gravitational) and the one responsible for beta decay—were essentially unknown. The discovery of parity nonconservation stimulated considerable experimental and theoretical work, which led to the present description of the weak force in terms of a local product of currents.

Beta Decay and Muon Capture touches on all aspects of weak decays, a subject on which Morita has been doing research for nearly two decades. The author's audience is restricted to those who have a basic knowledge of quantum mechanics—presumably first-year graduate students and beyond. Much of the material is self-contained, and the work is based on material he has presented in various graduate courses. However, although the book is quite suitable for use in a nuclear physics course, I am inclined to view it not as a text but rather as a lengthy review article. As such it makes first-rate reading. The discussion is usually clear. The references are extensive. Occasionally, as in the case of hyperon beta decays, Morita offers only a tantalizing glimpse of a subject. But in general, the discussion is more complete and more satisfying. Morita has included lengthy chapters on Fermi theory, parity nonconservation, and the $V - A$ interaction, in which the theoretical basis of our current picture of the decay process is carefully outlined. Numerous experimental consequences are explored. The range of possible experiments on a simple decay process is extensive, but the spectra become even more rich when the daughter nucleus produced in the decay is itself unstable and breaks up, emitting a photon (gamma ray) or alpha particle in the process. Studies of such beta-gamma and beta-alpha transitions permit isolation of small effects such as weak magnetism, which usually are obscured by much larger terms. In a subsequent section, the electron-capture and neutrino-scattering processes, which are related via crossing symmetry to the basic beta decay interaction, and, in addition, double beta decay, muon decay, and nonleptonic decays, which result from logical extensions of the semileptonic Hamiltonian, are described, but in considerably less detail.

The subject even has its "practical application," since the use of beta decay as a probe of nuclear structure is, of course, quite feasible provided the basic interaction is known, and in an interesting chapter the study of pairing correlations, Coulomb mixing, and other aspects of nuclear structure through measurement of weak matrix elements is illustrated. However, lest the reader believe that all is well understood, beginning in the late 1960's questions have again arisen as to the completeness of our knowledge of weak interactions. Recent experiments appear to have revealed charge-symmetry violation in mirror beta decays and larger circular polarizations in gamma decays than the naive Cabibbo Hamiltonian seems to permit. A concluding chapter mentions these problems, which are still under active experimental and theoretical investigation.

In the central portion of the text, Morita examines forbidden transitions and the remaining aspect of his subject—muon capture. The discussion seems to bog down here. I would prefer to have seen fewer equations—especially for forbidden transitions—and considerable amplification of the discussion of the mu capture process, including for example, relativistic corrections to Primakoff's equations, problems in explaining the neutron spectrum from capture to an excited nuclear state lying above the particle-emission threshold, and the interesting subject of radiative capture. Also, throughout the book the discussion is based on single-body currents—that is, the impulse approximation. It would have been useful to separate those aspects of the physics which are independent of any nuclear model from the explicitly model-dependent ones, with perhaps a section on mesonic exchange effects.

It is, however, much easier to find minor flaws in a book such as this than it is to write one. Morita has done a careful job in assembling the varied threads of this vast subject and has woven them into a very interesting and readable account.

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Organic Chemistry

Mechanisms of Elimination Reactions. WILLIAM H. SAUNDERS, JR., and ANTHONY F. COCKERILL. Wiley-Interscience, New York, 1973. xii, 640 pp., illus. $19.95.

Twelve years have elapsed since the appearance of Banthorpe's monograph on mechanistic aspects of elimination reactions, and although the many developments in this field have been regularly covered by review articles, there has been a need for a comprehensive book on the subject. This volume fills that need and is recommended with the same degree of enthusiasm which the authors display in writing it.

The first five chapters deal with the questions of rates, mechanisms, transition state character, stereochemistry, and orientation in heterolytic olefin-forming elimination. The coverage is complete and up to date. A particularly fine discussion of the *syn-anti* dichotomy extends the scope of the posthumous review of the subject by Sicher. Sections on the application of mechanistic tools such as isotope effects, linear free energy relationships, and acidity functions are prefaced by brief theoretical introductions that will assist the relatively uninitiated reader. The reviewer is a little disappointed that more use has not been made of More O'Ferrall's potential energy surface for E1, E2, and E1cB reactions in the discussion of transition state character. The so-called E2C mechanism is given little prominence, but while controversy surrounds this matter the fact remains that eliminations induced by weak bases are useful additions to the range of conventional synthetic methods, and a deeper treatment could perhaps have provided more pointers for synthetic chemists.

The remaining chapters deal with a