Book Reviews

Units of Matter

Atomic Physics 4. Proceedings of a conference, Heidelberg, Germany, July 1974. G. zu Putlitz, E. W. Weber, and A. Winnacker, Eds. Plenum, New York, 1975. xvi, 780 pp., illus. $59.

The fundamental physical principles governing atomic structure, as well as collision and radiation processes, were laid down some 50 years ago. The field is now passing through a remarkably vigorous middle age. The continued vitality of atomic physics is due, in part, to its relevance in areas of applied physics, such as space physics and the studies of plasmas and lasers, that are of current interest. Beyond this, however, one can point to an intrinsic richness of subject matter and an intellectually stimulating interrelation among the various subfields. Since 1968 there have been four international conferences set up to review the state of fundamental research in atomic physics. *Atomic Physics 4* is a compilation of more than 30 invited papers delivered at the latest of these conferences. The papers give authoritative summaries of recent advances and indicate possibilities for future developments and applications.

A very nice example of the intimate connections that may exist between apparently unrelated subfields appears in the paper by Berndt Müller, R. K. Smith, and Walter Greiner, who discuss the possibility of positron production in heavy-ion collisions. If the subject is viewed as a problem in quantum electrodynamics, the interest lies in the study of electronic states that disappear into the negative-energy continuum when the binding potential is strong enough. Fields of sufficient strength may be realized through the temporary formation of superheavy molecules in heavy-ion collisions. The positron production analysis depends critically on a knowledge of the probability that a K-shell vacancy will be produced in the collision. One is led then to a study of the quasi-molecular model of atomic collisions and an analysis of radiative transitions in quasi molecules. This is a subfield of interest in its own right; several reviews, covering different aspects of the subject, appear in this volume.

The traditional method for testing the validity of quantum electrodynamics is by comparison of measured and predicted energy levels in light atoms. Such tests become more stringent, and therefore more interesting, as experimental techniques are refined. At the same time they provide increasingly precise values for the fundamental constants. Theo W. Hänsch reports a new measurement of the Rydberg constant, of dramatically improved accuracy. This is made possible by recent advances in high-resolution spectroscopy with tunable lasers, a subject reviewed extensively elsewhere in the volume.

Lasers are now also being used in atomic collision physics, thus opening up a new area of investigations. As described by I. V. Hertel, atoms, prior to their collision with a beam of electrons, can be prepared in states of definite spin projection by allowing them to interact with laser light of the proper frequency. By eliminating the need to average over spin projections in the analysis of the experiment, information (such as the phases of the scattering amplitudes) hidden in conventional experiments can now be revealed.

Atomic collision theory has developed in parallel with experimental refinements. Currently, multiple scattering methods of the Glauber type are under intensive study. One wants to know why they work as well as they do, and where precisely they fail. F. W. Byron, Jr., gives a clear introduction to the subject and indicates the connection between the Glauber approach and conventional perturbation theory.

This somewhat random sampling of topics covered in the book cannot properly indicate its scope. Taken as a whole it provides a comprehensive overview of the present status of basic atomic physics research; it will be a useful reference work for expert and nonexpert alike.

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Magnetospheric Science

Physics of the Hot Plasma in the Magnetosphere. Proceedings of a symposium, Kiruna, Sweden, Apr. 1975. Bengt Hultqvist and Lennart Stenflo, Eds. Plenum, New York, 1975. x, 370 pp., illus. $25. Nobel Symposium No. 30.

In April 1975, some 40 magnetospheric scientists met in Kiruna, Sweden, to discuss some basic problems of their field. Their meeting resulted in this book, a collection of 16 highly specialized papers on a variety of relevant subjects. It is not a book for beginners, nor can it be regarded as a textbook or a review.

The 16 papers are only loosely coupled, but two groups can be discerned among them. First, there are studies of waves and fluctuations in the magnetospheric plasma, by Ashour-Abdalla and Kennel, Galeev, Scarf, and Hultqvist, the first three of them having a distinctly theoretical-mathematical flavor. Secondly, there are papers on outstanding puzzles of the magnetosphere, on observed features that fit neither prediction nor accepted theory, such as the energetic oxygen ions described by Johnson *et al.* or the low-altitude acceleration processes reviewed by Evans. This group may also include the heretical but cryptic introductory paper by Alfvén and the contributions of McIlwain and Block: they all seem to imply that, contrary to naive plasma theory, electrical potential differences do sometimes develop along magnetospheric field lines, in ways we still do not understand. The remaining chapters deal with miscellaneous magnetospheric topics and regions, such as the boundary layer, the plasma sheet, Birkeland currents, and plasmas near synchronous orbit.

Although most papers deal with timely subjects, this collection also has many flaws. It consists of facsimile typescripts, which gives it an unfinished appearance, the chapters are disjointed, and some of them lack key illustrations or summary sections. There is no record of the discussions (which, one participant told me, were an important part of the symposium), nor is there any overall review of the meeting. Most important, perhaps, much of the material has the nature of reports on individual research rather than reviews of various subjects of interest.

Thus, I would recommend the book to any major scientific library, but at the same time I cannot help thinking that much of this material should have appeared in regular journals—in particular those papers (such as McIlwain's) that

contain brand-new results. I realize that an increasing number of authors prefer this sort of publication over the uncertain gauntlet of peer review, which can delay or block the communication of results, sometimes unfairly. Nevertheless, the journals are where such work belongs, not merely because of their editorial and printing standards, but mainly because they reach a far larger fraction of the scientific community than any other mode of communication.

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Organoboron Compounds

Organoborane Chemistry. THOMAS ONAK. Academic Press, New York, 1975. xii, 360 pp., illus. $38. Organometallic Chemistry.

This book on a rapidly growing branch of organometallic chemistry is timely and welcome, despite the fact that it is the fourth monograph published within the past five years in which recent contributions by H. C. Brown and his associates occupy the central position. The three earlier books are: H. C. Brown, *Boranes in Organic Chemistry* (Cornell University Press, 1972); H. C. Brown with G. W. Kramer, A. B. Levy, and M. M. Midland, *Organic Syntheses via Boranes* (Wiley-Interscience, 1975); and G. M. L. Cragg, *Organoboranes in Organic Synthesis* (Dekker, 1973). The first is a lucid, semiautobiographical account, mainly describing Brown's own contributions and those of his associates, and the literature coverage is necessarily limited. The second book is a sequel to the first and emphasizes details of experimental procedures. The literature coverage in the book by Cragg is more extensive, but its focus is entirely on organic synthesis.

In contrast, the book under review is basically an encyclopedic reference book. The literature coverage, with approximately 2000 references, appears to be reasonably comprehensive through 1972. For example, of some 30 organoboron papers published in 1972 by H. C. Brown, all but a few are cited. Another useful feature is the inclusion of about 40 tables of various physical constants and of various types of organoboron compounds classified according to their structure.

As it is in most other reference books, the discussion of the subject matter is concise and, in general, lacking in depth. In some cases even results that were shown to be erroneous by later studies are presented as originally reported, together with the corrected ones. This tendency seems most pronounced in chapter 5.

An intentionally brief 20-page discussion of the chemistry of organopolyboranes in chapter 6 does not provide the reader with the overall picture. A more penetrating discussion would have served as a bridge between the coverage of organopolyboranes and that of organomonoboranes, two major branches of organoboron chemistry that have been almost totally isolated from each other. Several largely independent topics in chapter 7 might as well have been incorporated in earlier chapters. As it is, some of them might elude many readers.

The book may be recommended to those who are interested in a comprehensive source of literature in this field. It should prove particularly valuable when used in conjunction with the other recent monographs.

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Solution Chemistry

The Organic Chemistry of Electrolyte Solutions. JOHN E. GORDON. Wiley-Interscience, New York, 1975. xxii, 554 pp., illus. $27.50. Interscience Monographs on Organic Chemistry.

The book under review can best be described as an unusually comprehensive review of electrolyte solution chemistry with emphasis primarily, but not exclusively, on aspects pertinent to organic chemistry. The most striking characteristic of the book is its breadth. Virtually every aspect of solution chemistry receives sufficient coverage to introduce the reader to current views and to guide him to the original literature. There is no other single book that meets this need.

The book is divided into sections on salt effects, ion solvation, and ion association. Roughly the first half of each section deals with the general principles and extant theories in the area, and the second half of the section presents examples of the applications of these principles and theories to studies of organic reactions. The coverage in each section ranges over aqueous, dipolar aprotic, nonpolar, and molten salt solutions, and includes consideration of micelles and various ion-complexing agents such as the crown ethers. Mixed solvent systems are also discussed in each section, and proper attention is given to the importance of endostatic conditions. There is considerable emphasis throughout on water structure and hydrophobic interactions. The author appears to favor, perhaps unduly, the Frank and Wen model and the importance of ice I structure. Nearly every technique that has been applied to the study of solution properties is mentioned and referenced at the appropriate point.

The section on salt effects is particularly thorough in its treatment of the mutual interactions of salts and nonelectrolytes in solutions. The coverage beautifully updates the now quite old (1952) review of this subject by Long and McDevit.

I heartily recommend the book to researchers in solution chemistry. Its major utility will almost certainly be as a guide to the literature. There are over 1800 references, and the coverage is quite thorough through the middle of 1973. Tables are extensive enough to serve as data references in a few cases, but more frequently they are designed for illustrative purposes or as guides to the original literature. The presentation of material is largely neither critical nor selective. Throughout, the book tends to lapse into the style of annual reports of the Chemical Society, presenting what is essentially an annotated bibliography. Perhaps this is unavoidable in coverage of such breadth of fields in which firm conclusions are rare. Nevertheless, the general failure to distinguish between questionable and generally accepted theories or results diminishes the book's value as an introduction to the field.

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Infrared Spectroscopy

Metal Carbonyl Spectra. P. S. BRATERMAN. Academic Press, New York, 1975. x, 286 pp., illus. $22.25. Organometallic Chemistry.

Braterman's book is mainly about the infrared spectra of transition-metal carbonyl compounds. Although this may seem to be a rather narrow subject for an entire book, the references in the far from comprehensive list number 378. Intest in the infrared spectra of the metal carbonyls derives in part from their central place in inorganic and organometallic chemistry. In addition, the generally intense absorptions due to the carbonyl stretching modes furnish textbook examples of specific group frequencies. The relatively simple patterns of lines in