Book Reviews

Developments in Transport Theory. Ed. by E. Inönü and P. F. Zweifel, Academic Press, New York (1967). 380 pp. $19.50.

Developments in Transport Theory is the result of the NATO Advanced Study Institute held in Ankara, Turkey in 1965. Neutron transport theory, radiative transfer, and plasma theory are all discussed with most of the emphasis on neutrons. Almost all of the attention is directed to linear or linearized transport theory. The proposed goal of discussing similarities and differences of transport theory problems and methods was achieved by a considerable and successful effort of relating the results from the several fields. Each lecturer and seminar contributor developed his area with admirable skill and clarity, giving sufficient detail for understanding and adequate references for results not obtained directly. Although the detail and rigor are not always as great as found in *Linear Transport Theory* by Case and Zweifel, the interested reader should encounter no particular difficulties in following any of the developments.

K. M. Case initiates the lectures with a development of some of the requisite mathematical tools in "Methods for Solving Linear Transport Problems," including a resume of generalized functions and singular integral equations. Numerous simple applications in plasmas and neutron transport are developed to illustrate the techniques.

P. F. Zweifel opens the second lecture series with a discussion of the significance of the approximations used in obtaining one-speed, one-dimensional "Neutron Transport Theory" from the general form. Various explicit topics (eigenfunctions, eigenvalues, orthogonality, normalization and completeness relations, to mention a few) are examined in detail, while others are summarized. Finally, the picket fence model in radiative transfer is discussed in terms of the solution to a singular integral equation.

John C. Stewart begins "Some Topics in Radiative Transfer" with a discussion of basic definitions and the local thermodynamic equilibrium hypothesis (LTE). Non-LTE problems are discussed and a delineation of the neutron transport theory counterparts to LTE for five radiative transfer problems is made, including a discussion of their physical reality. Finally, a class of tractable problems is reviewed and a numerical technique (the Rybicki-Usher transformation) for varying optical properties is summarized.

W. Kofink reviews "Recent Developments in the Spherical Harmonics Method" for solving the neutron transport equation in plane geometry using the 2^{L+1} multipole error source term and relates Gauss quadrature and P_L results for various interesting cases. The Sonine transformation is developed and utilized to obtain "New Integral Solutions of the Boltzmann Equation in Spherical Geometry" in some detail including regular and singular solutions and comparison with spherical harmonics.

Carl Oberman reviews problems in fully ionized "Plasmas." The Vlasov equation is derived and the instability of a linearized electrostatic plasma oscillation discussed. Using the Bogoliubov Ansatz on the equations of order 1 in ϵ (inverse number of particles in Debye sphere) the kinetic equation for the time evolution of a distribution is derived and discussed. Finally, a simple physical model is developed from the Vlasov equations to investigate the frequency dependence of resistivity and absorption and emission of radiation. Limiting forms are compared favorably to other calculational results.

I. Kuščer opens the last lecture series by summarizing some of the forms and physical assumptions made in neutron "Transport Problems for Thermal Neutrons." A discussion of scattering laws, eigenfunction expansions, diffusion parameters, the reciprocity theorem, and decay times with specific model applications follows with special emphasis being made to validity and unsolved problems.

Eight seminars are included as appendices supplementing and expanding on various aspects of the main lectures.

The editors are to be commended for retaining the freshness of the lecture with the detail of a text in this book. A few typographical errors slipped through, but none that should cause the reader any difficulty. The type and format are quite legible.

In summary, this book contains an eloquent comparison of transport theory problems, is highly readable and could readily supplement the students' overall view of the field, in learning about the techniques and the problems present and unsolved.

Clarence E. Lee

Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87544

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About the Reviewer: Clarence Lee is a member of the Theoretical Physics Division of the Los Alamos Scientific Laboratory. His work in reactor physics includes contributions to neutron transport, stochastic theory of neutron multiplication, and delayed-neutron multiplication. He is a member of the American Nuclear Society and American Physical Society.

Hydrogen Bonding in Solids. By W. C. Hamilton and J. A. Ibers. W. A. Benjamin, Inc., 1 Park Ave., New York, N.Y. (1968). 284 pp. $13.95.

This 284-page book (including an 18-page index and nearly 20 pages of references) is divided into eight chapters. The first one is devoted to basic concepts and definitions in the theory of solids and chemical bonds. The following three chapters give a short description of the different diffraction methods (X ray, electron, and neutron) and spectroscopic techniques (NMR, infrared absorption, Raman and neutron inelastic scattering) commonly used in the study of bonded structures.

Chapters 5 through 7 contain the bulk of the material specifically related to hydrogen bonding and show the considerable experience and knowledge acquired by the authors in this field. A large variety of cases of hydrogen bonding are described as they occur in organic and biological molecules (Chap. 5) as well as in inorganic crystals (Chap. 6) and in the very interesting case of ferroelectrics (Chap. 7).

The last chapter is a two-page statement of the authors' expectations concerning the future improvement and development of the techniques used in the study of hydrogen bonding.

A long table of neutron diffraction data relating to hydrogen bonded systems is included as an appendix.

The authors claim in the introduction that the book is written at a level which should make it useful as a text for a graduate or advanced undergraduate course in structural chemistry. While the material of Chaps. 5 through 7 should be of considerable value to the specialist as reference information, the description and analysis is in many cases much too short to meet the needs of a graduate course. Fewer examples treated in more detail would probably be more desirable in a textbook.

Also the theory of diffraction and inelastic scattering given in the first half of the book is too sketchy to be of practical value. Any standard elementary book on this subject will give a more detailed and rigorous treatment of the theory underlying these techniques. Instead of this material the reviewer would have preferred to see some chapters devoted to the basic theory of hydrogen bonding in the framework of chemical bonds in general. In fact, although frequent reference is made to van der Waals, covalent and other forces, not the slightest effort is made to inform the reader of the present status of theoretical understanding of these bonds. A possible justification of this neglect of the theoretical aspect of the subject is that the book is clearly oriented towards the experimentalist. Thus, the emphasis is always on recipes for analyzing the data rather than on the fundamental theory underlying the experiment.

The book is well illustrated featuring a large number of figures in each chapter. Many of the complicated crystalline structures are illustrated by stereoscopic drawings which may be observed with a hand-held viewer which comes with the book.

J. U. Koppel

Gulf General Atomic
San Diego, California 92112

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About the Reviewer: Juan Koppel joined General Atomic in 1961 where he is participating in theoretical studies of the integral neutron thermalization program. His earlier efforts in nuclear energy contributed to the design of the first Argentine reactor and, at various times in his career, he has been associated with the Max Planck Institute for Physics, with the nuclear center at Saclay, and with Brookhaven. He recently completed graduate work at the University of California. Dr. Koppel's current interest is in solid-state physics and, particularly, in the interaction of neutrons with matter, in crystal lattice dynamics, and in the electronic energy band structure of metals.