

# BOOK REVIEWS

Selection of books for review is based on the editors' opinions regarding possible reader interest and on the availability of the book to the editors. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.



## FROM OUT OF THE PAST

*Title* Molecules, Crystals, and Quantum Statistics

*Author* Enrico Fermi

*Publisher* W. A. Benjamin, Inc.

*Pages* xiv + 300

*Price* \$12.50

*Reviewer* L. W. Nordheim

This book is a translation from the Italian original written by Fermi in 1934. It was intended as a text for European students on a level that corresponds here to advanced undergraduate standing. The first obvious question is, "Does this resurrection serve a useful purpose?" The answer is an emphatic and unqualified "yes." The time of writing was in the heroic age of physics, when the advent of quantum mechanics opened the door for a real understanding of the structure of matter and where the fundamentals were laid for most of our present theories. The author, one of the giants of those days, combined in a unique fashion creative imagination with unsurpassed lucidity. Thus, the book, which represents much of Fermi's research interest at that time, though not up to date, is by no means out of date. It gives, with a minimum of mathematical formalism, a very clear and intuitive presentation of basic modern physics of a "classic" nature.

The book is divided into three fairly independent parts. The first part, dealing with molecules, discusses the Heitler-London theory of the covalent bond, the spectra of diatomic molecules with special emphasis on selection rules, spin-orbit coupling, nuclear spin, and molecular statistics. The Raman effect and thermal properties are also treated in some detail. The last section of this part is devoted to polyatomic molecules; it discusses their symmetry properties, normal modes, and selection rules for infrared and Raman spectra.

The second part deals with the theory of crystals from an atomic point of view. It gives a short review of the symmetry properties of crystal lattices and their

structural analysis by x-ray diffraction. Physical properties are discussed, such as specific heat, thermal expansion, optical properties, and lattice energies of ionic crystals.

The last part is devoted to statistical mechanics. The Boltzmann distribution is generalized to quantized systems. It is then shown how quantum mechanics requires a different accounting, and the Bose-Einstein and Fermi-Dirac statistics are introduced with various applications. The book ends with a discussion of the Thomas-Fermi atom.

The requirements for understanding are modest: an elementary knowledge of quantum mechanics and atomic physics, and some general background in classical physics. However, the book demands careful reading to follow the tight and concise arguments.

For whom will this book be useful? For the mature physicist for the sheer delight of reading and as a refresher for his memory, for the teacher for the simple representation of many difficult points, and for the student for giving him the physics arguments without drowning him in formalism.

However, this is not a textbook in the usual sense. It deals mostly with principles, illustrated generally by only one example, and with no problems. Also, of course, newer developments are not covered. Besides the above, the book will also appeal to the non physicist who needs an introduction to any of the subjects covered.

The translation is well done and reads easily. The editor has provided a valuable list of references to the original literature on which the book is based. He has also tried to introduce a few newer developments in some appendixes; in this he has been less successful, as they remain rather sketchy and not too informative. In my opinion, it would have been preferable to give a separate list of references from the newer literature with annotations and page numbers.

There are some minor points of criticism. The reproductions of some actual spectrophotographs are poor, and there are a few points with which this reviewer does not quite agree with the author. A major complaint is about the comparatively high price for this small volume, which defeats the purpose of a wide distribution. It is to be hoped that in time a less expensive paperback edition will be issued so this admirable book can reach all who will profit from it.

L. W. Nordheim joined the General Atomic Division of General Dynamics in 1956 where he is a Senior Research Advisor and Chairman of the Theoretical Physics Department. He obtained his PhD in Goettingen, Germany, in 1923. He was Professor of Physics at Duke University, 1937-56. He joined the Manhattan Project in 1943 and remained at ORNL till 1947. He also was resident consultant at Los Alamos, 1950-52. His work covers a wide area in quantum mechanics and statistics, cosmic rays, and nuclear and reactor physics. He received honorary degrees from Karlsruhe, Germany, and from Purdue University. He is a fellow of the ANS and of the APS and a member of the Advisory Committee for Reactor Physics of the AEC. He met Fermi for the first time at Goettingen in 1925 and later on numerous occasions.

### MORE THAN THE CLASSIC DISCUSSIONS

*Title* Physics of Nuclear Reactors

*Author* D. Jakeman

*Publisher* American Elsevier Publishing Co., Inc., 1966

*Pages* xii + 356

*Price* \$10.00

*Reviewer* Noel Corngold

According to the flyleaf and to the prefatory paragraphs, Dr. Jakeman's book is intended for graduate engineers and physicists who wish to become acquainted with the "Physics of Nuclear Reactors." "But," the American reader will say, "what about 'Glasstone and Edlund'?" A proper review should keep Glasstone and Edlund's classic text in mind.

Both books contain a little nuclear physics, and straightforward discussions of elementary diffusion theory and neutron slowing down. Glasstone and Edlund's book is longer, because the style is leisurely and the authors are attentive to detail. Dr. Jakeman often refers the reader to Glasstone and Edlund for the proof of a particular formula. He cannot maintain a leisurely pace because he has so much more material to discuss. Here, I think we have the distinction between the two books. Dr. Jakeman believes that his book, which appears 15 years later than Glasstone and Edlund, should contain more than the classic discussions of neutron diffusion. He writes a chapter on Fast Reactors, another on Neutron Thermalization, and one on Nuclear Fuels. He presents enlightening graphs of the variation of  $\eta$  with neutron energy, and of the behavior of energy eigenfunctions in thermalization. There is, no doubt, more "physics" in Jakeman's book than in Glasstone and Edlund's. Details in the treatment of classic problems in neutron diffusion are sacrificed to achieve timeliness.

As one might guess, from the listing of subject matter, the technical level of Jakeman's book varies considerably from chapter to chapter. And, though the treatment is generally acceptable, experts can carp at the accuracy of the treatment of their subjects. For example, the apparent conflict between the "American formula"  $a + b(S/M)$  and the "Russian formula"  $c + d \times \sqrt{S/M}$  in the theory of resonance capture, was resolved, at least seven years ago, through the research of J. Chernick and his collaborators. In the chapter on thermalization, several of the equations appear to be muddled, and J. E. Wilkins is denied the credit of first constructing the heavy-gas equation.

In spite of these errors in scholarship, and the variation in difficulty from chapter to chapter, *Physics of Nuclear Reactors* is well-written and interesting. Doubtless, it will convey to many outsiders a feeling for "modern" reactor physics.

Noel Corngold is Group Leader in Theoretical Reactor Physics at Brookhaven National Laboratory. He received training in physics at Columbia and Harvard (PhD 1954), and is particularly interested in the theory of neutron transport.

### SHORT BOOK - SHORT REVIEW

*Title* Advances in Insect Population Control by the Sterile-Male Technique

*Publisher* International Atomic Energy Agency, 1965

*Pages* 79

*Price* \$2.00

*Reviewer* David Pimentel

The book, *Advances in Insect Population Control*, is a summary of various aspects of field and laboratory experiments employing the sterile-male technique as reviewed by scientists from many countries at the International Atomic Energy Agency Conference held in Vienna in 1965. This report contains information of a general nature on the subject. Scientists interested in initiating research will not find details in techniques of sterilizing flies, nor methods of evaluating results.

Of special concern to scientists working in this program should be the section on "Integration of the Sterile-Insect-Release method with other means of Control."

Although the report includes a reference list of 52 papers presented at the Conference, the inclusion of a more extensive bibliography would have enhanced the usefulness of this report.

David Pimentel is Professor of Ecology and Head of the Department of Entomology and Limnology at Cornell University, a post he assumed in 1963. He is the co-author of a book, *Systems Analysis in Ecology* (in press). His BS (1948) is from the University of Massachusetts, and his PhD (1951) is from Cornell.