

This book is clearly and concisely written with a large but carefully selected number of figures. Particularly commendable is the fact that the instrument illustrations are accompanied by a very clear description in the text so that the functioning and design of a given piece of equipment can be easily followed and understood. This book should be heartily welcomed by workers in the field, particularly those who have assumed the experimental responsibility of determining number-average molecular weights and related thermodynamic properties.

POLYMER STRUCTURE SECTION
NATIONAL BUREAU OF STANDARDS LEO MANDELKERN
WASHINGTON 25, D. C.

Annual Review of Nuclear Science. Volume 8. EMILIO SEGRÈ, Editor, University of California, GERHART FRIEDLANDER, Associate Editor, Brookhaven National Laboratory, and WALTER E. MEYERHOF, Associate Editor, Stanford University. Annual Reviews, Inc., Grant Avenue, Palo Alto, California. 1958. vii + 417 pp. 16 × 23 cm. Price, \$7.00 (U.S.A.); \$7.50 (elsewhere).

The volumes of "Annual Review of Nuclear Science" have probably become so familiar to most persons interested in pure and applied nuclear physics, that the reviewer might dispense with a general description of the character of this series. For the few uninitiated readers, it may be stated that each volume contains a collection of about a dozen articles, with a balanced distribution between pure nuclear physics and its applications to chemistry, biology, geology, etc. No effort is made to cover every year advances in all branches of nuclear science. The much more opportune procedure followed is to review each year those fields where a considerable amount of knowledge has accumulated since the last review appeared in this series or elsewhere, and therefore it is desirable that the present status of the problem be summarized. In the past such articles have proved invaluable both to the specialist in deciding the direction of his future investigations, and to the person wishing to survey a field close to but not exactly his own. One feature that greatly enhances the value of these books, and for which editors and authors must be congratulated, is the short time elapsing between the appearance of results in the technical papers and their coverage in these reviews. In the present volume, literature up to the spring of 1958 (about 6 months before the appearance of the book) is fully taken into account, and even data personally communicated to the authors and still unpublished at that time are included.

The volume opens with a high-caliber article of a theoretical nature, *Invariance principles of nuclear physics* by G. C. Wick. Parity, charge conjugation, time-reversal, charge independence, baryon and lepton conservation, and strangeness are discussed. These problems are viewed from the vantage point of the field-theoretical methods of quantum mechanics, and the treatment is masterful in its clarity and completeness. In contrast to many articles on parity non-conservation and related subjects that have appeared elsewhere, this is definitely not an elementary approach for the uninitiated.

The optical model and its justification, by H. Feshbach, covers the principles and applications of a method for reducing many problems of nucleon-nucleus interaction to the study of a two-body system. The article is excellently written and condenses material previously scattered in numerous and lengthy papers.

Hyperfragments, by W. F. Fry, is a brief but comprehensive account of the properties of light nuclei where a neutron is replaced by a lambda-zero hyperon. These peculiar objects supply valuable information on strange-particle interactions.

Antinucleons by E. Segrè is a clear and authoritative account of the discovery and properties of these constituents of "antinmatter."

Gamma-ray spectroscopy by direct crystal diffraction, by J. W. M. DuMond, is an excellent review of the work done by the author (who spent a life-time in perfecting high-resolution X-ray and gamma-ray spectrometers) and by a few others who have undertaken these difficult experiments. This technique of measuring gamma-ray wave lengths, while requiring exceptionally strong sources, supplies a precision unequalled by any other method. A large number of lines

have been determined, which will serve the same purpose as standard wave lengths in optical spectra.

Conceptual advances in accelerators, by D. L. Judd, is a compact but complete summary of the principles involved in the design of the present accelerators and of the ideas advanced, in this country and elsewhere, to improve attainable energy, current intensity, accessibility of the beam, length of duty cycle, and other desirable features. The alternating-gradient focusing has been the greatest advance of the past few years; intersecting-beam accelerators to attain higher useful particle energies, and use of plasma to increase current intensities, are some of the ideas that have been proposed, but their practical application seems rather remote.

The primary cosmic radiation, by H. V. Neher, describes the chemical composition of the primary cosmic-ray particles in relation to the abundance of nuclear species in the universe. The energy distribution and the suggested mechanisms of cosmic-ray acceleration also are discussed.

The radioactivity of the atmosphere and the hydrosphere, by H. E. Suess, describes recent determinations of tritium, C¹⁴, and other radioactive elements, either liberated from radioactive elements in the earth, produced by cosmic-ray interactions in the atmosphere, or introduced by man's nuclear explosions.

Geochronology by radioactive decay, by L. T. Aldrich and G. W. Wetherill, deals with a subject that had been reviewed in this series only 4 years ago. The necessity for a new summary emphasizes the progress realized in this brief period. The potassium and rubidium methods, in their infancy at that time, now rival the uranium-lead methods in accuracy and are of much more general application as they involve common elements. Excellent consistency exists on the ages of many pre-Cambrian igneous rocks. On the other hand, no progress has been made on the important task of pegging the conventional geologic time-scale, from the Cambrian to the Recent, to absolute, radioactively determined dates. Geologists still rely on a few points, determined many years ago and open to question. A massive attack on this problem is urgently needed. The present article deals essentially with the methods of age determination rather than their geological implications.

Nuclear astrophysics, by A. G. W. Cameron, is a most interesting account of our present knowledge of nuclear reactions going on in the stars, in relation to the origin and abundance of the various nuclear species.

Practical control of radiation hazards in physics research, by B. J. Moyer, should prove useful to many nuclear physicists, chemists, etc., whose notions about the dangers of exposure to radiations seem generally rather vague, if the reviewer and his associates can be taken as examples.

The purpose of cellular radiobiology, by T. H. Wood, is, in the author's words, "a review of those papers published in 1957 that deal with the effects of ionizing and ultraviolet radiations on simple biological systems." The large bibliography cited and the frequency of reviews in this field indicate its rapid development. A special topic of this subject, *Information theory in radiobiology*, is the object of a separate, brief article by H. Quastler. It discusses the statistical principles that govern in an organism the macroscopic consequences of the primary radiation effects.

The above summary of the contents of the individual articles clearly shows that the eighth volume of this series is fully as useful as its predecessors to all students of pure and applied nuclear science. The list of authors and topics for the forthcoming 1959 issue will doubtless induce a feeling of keen expectation in all those interested in what probably is the fastest progressing branch of human knowledge.

JOHNS HOPKINS UNIVERSITY
BALTIMORE, MARYLAND

FRANCO RASETTI

Internal Conversion Coefficients. By M. E. ROSE, Chief Physicist, Oak Ridge National Laboratory. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1958. xxi + 173 pp. 23 × 30.5 cm. Price, \$6.25.

The internal conversion of γ -rays supplies a most useful tool to the investigator concerned with unravelling nuclear decay schemes; it also supplies a very nice example, with a fair number of subtle features (some of which have been apparent only in the last couple of years), of the interaction of a system of charged particles with the electromagnetic field.

The essential fruit of the theory of internal conversion appears as a number (the "internal conversion coefficient") which gives the relative probability that an electron from a given sub-shell or a γ -ray will be emitted when a nucleus makes a transition from one state to a lower one. The present volume gives, in about 140 pages of tables, internal conversion coefficients for the K shell and the L subshells, for both electric and magnetic type transitions of orders 1 . . . 5 (dipole, quadrupole, etc), for 10 values of the transition energy and for each Z between 25-95. A smaller table gives coefficients, calculated less precisely, for the M subshells. As one who, several years ago, calculated three internal conversion coefficients, the reviewer can attest to the enormity of the project which produces the 30,000 coefficients of the present volume.

As Dr. Rose points out, the computation spanning a period of 10 years has gone through several stages of sophistication beginning with a model using a point-charge nucleus and no atomic screening and then removing the restrictions. The K and L tables give coefficients in which screening and the static nuclear effects are considered and as such may almost be regarded as complete and final. In some cases, as shown not long ago by Sliv, a dynamical nuclear effect (involving the current density in the nucleus, not simply the charge density) could modify the coefficients. These effects depend on the detailed model and as such cannot be tabulated. Even so, Rose does give some auxiliary tables which would be useful in considering them.

The present volume extremely well satisfies the needs of those who use internal conversion as a research tool, and the reviewer has only one quarrel with it. It does seem a pity that only 10 pages are given to a discussion of the theory. It would have been reasonable to accommodate the reader not concerned with measurements by giving in detail the theory of the process, discussing the subtle features (even the name "internal conversion" derives from an early misunderstanding) and perhaps even describing the recent work done by Sliv, Rose and others in studying explicit nuclear structure effects by means of internal conversion.

DEPARTMENT OF PHYSICS
UNIVERSITY OF ROCHESTER
ROCHESTER 20, N. Y.

J. B. FRENCH

Proceedings of the International Symposium on Transport Processes in Statistical Mechanics, held in Brussels, August 27-31, 1956. Sponsored by The International Union of Pure and Applied Physics, Institut Solvay (Université Libre, Brussels) and European Office, Air Research and Development Command, United States Air Force (Brussels). Edited by I. PRIGOGINE, Professor of Physical Chemistry and of Theoretical Physics, Université Libre, Brussels, Belgium. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N.Y. 1958. x + 436 pp. 16 × 23.5 cm. Price, \$10.00.

The symposium reported in this book was held in August, 1956. In the foreword, dated October, 1957, Editor Prigogine comments: "As Professor Uhlenbeck once observed, statistical mechanics is a slowly growing subject in which short periods of rapid development are followed by longer periods of stagnation. Today, it seems as though we are in one of the periods of rapid development." The book appeared in December, 1958.

The volume contains 48 articles by 58 authors. To my knowledge, about 30 of the articles contain material which has been reported in other places (much of this since 1956). Eight articles deal with experimental studies of transport phenomena: the remainder are entirely theoretical. The derivation of the Boltzmann equation is discussed in five articles, and about ten articles are devoted to irreversible thermodynamics and the Onsager reciprocal relations.

The longest, and perhaps the most interesting, article is "Molecular Dynamics by Electronic Computers," by B. J. Alder and T. Wainwright. Although this work has been discussed far and wide at meetings and colloquia, this is its first appearance in print. Alder and Wainwright used fast electronic computers to solve exactly the simultaneous equations of motion of about 100 particles which interact either as rigid spheres or with square-well potentials. Their

article contains the most detailed information yet published on molecular dynamics in many-body systems.

The article "Theory of the Vibrational Relaxation of Diatomic Molecules" by E. W. Montroll will be of particular interest to physical chemists. This is a lucid summary of the mathematical treatment, due to Montroll, Shuler and others, of the statistical aspects of vibrational relaxation processes. It also contains some comments on the theory of chemical kinetics—a branch of the theory of transport processes which has otherwise been neglected in this volume.

All through the symposium, fundamental questions received the major emphasis. One can, apparently, derive the Boltzmann equation and the Onsager reciprocal relations in many ways. But, as Professor Uhlenbeck observed (on page 24), ". . . the real test of these developments will come if they are extended to . . . systems where we *do not* know the answer. . . . At present, as Ehrenfest would say, nothing certain is known." Prigogine's period of "rapid development" should be considered in this light. In the two and a half years since the symposium was held, no one has succeeded in computing a transport coefficient in a real gas at densities where the Boltzmann equation no longer holds. There has been virtually no discussion of the limits of validity of the Onsager relations. The applicability of the Boltzmann equation to low density plasmas is being hotly disputed. There have been substantial advances in the theory of superfluidity and superconductivity, but curiously enough these advances have come from equilibrium rather than transport considerations.

This book contains an excellent summary of the state of our knowledge (or ignorance) about the statistical theory of transport processes in 1956. It is not yet out of date.

NATIONAL BUREAU OF STANDARDS
WASHINGTON, D. C.

ROBERT ZWANZIG

Annual Review of Physical Chemistry. Volume 9. H. EYRING, Editor, University of Utah, C. J. CHRISTENSEN, Associate Editor, University of Utah, and H. S. JOHNSTON, Associate Editor, University of California. Annual Reviews, Inc., Grant Avenue, Palo Alto, California. 1958. vii + 511 pp. 16 × 23 cm. Price, \$7.00 (U.S.A.); \$7.50 (elsewhere).

Another year has brought with it another volume of the "Annual Review of Physical Chemistry." The general form of these publications must be so familiar to physical chemists by now that it only seems appropriate to note differences from the volume of the year before. The 1958 edition does not have articles on Electrode Processes, Combustion and Flames, Physical Chemistry of Proteins, and Bond Energies, all of which appeared in 1957; it has added articles on Statistical Mechanics, High Pressure Developments, Optical Rotatory Power, and Colloid and Surface Chemistry. The quality of the reviews is very similar to that in previous years.

Because of the inevitable time lags inherent in publication, no reference is significantly less than a year old by the time the Annual Review appears. A research specialist cannot afford to wait this long to learn which papers he should look at in his field, and he can only use the article on his specialty to see whether the reviewer turned up something important that he himself missed. The value of the reviews must be more to people who can afford to follow the literature at a more leisurely pace or who want to learn of significant developments in fields they are not actively working. It is for these that the reviews serve a real and useful purpose.

As usual, each reviewer in the volume is guided by one of two different philosophies. Some try to be as complete as possible in their coverage of the annual mountain of literature on their subject. Others select a few topics for really critical discussion and let large sub-topics pass unmentioned. A few years ago I myself perpetrated a review in the "complete" style. As I look at the various reviews in this volume, I am impressed with how much more valuable are the reviews that cover only a few topics in a critical and readable style. They must also be much harder to write.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF OREGON
EUGENE, OREGON

RICHARD M. NOYES