ground in their interest in the primary physical processes and, very often, in the experimental techniques employed. The study of the correlation of the primary physical processes with their immediate chemical effects is best conducted on gaseous systems. Mass-spectrometric techniques applied to such systems have yielded valuable information. Only three papers were devoted to this part of the subject.

Three branches of the subject are especially active: the physical and chemical behavior of epithermal atoms produced by nuclear transformations; the roles of hot reaction processes, diffusion-controlled thermal processes, and, possibly, ion–molecule reactions that follow nuclear transformations in liquids; and the effects of nuclear changes in solids. These nuclear changes in solids are considered as a variety of radiation damage.

The first of these fields is the veritable hot atom chemistry. Nuclear transformations provide the best means of producing highly energetic T, ^{11}C, ^{18}F, and other atoms. These nascent species generally become neutral before they are involved in chemical reactions in gaseous systems. By the use of moderators and scavengers, the reactions of the hot species can be distinguished from the purely thermal reactions, which are the fate of those atoms that fail to react in the epithermal region. These studies, pursued especially by Rowlands, Wolf, and Wolfgang and their collaborators, are rapidly mapping a new area of physical chemistry. The theoretical kinetic analysis of the data from these experiments, developed by Estrup and Wolfgang, has now been tested more extensively. However, the papers presented show that the precise limitations of the theory and the significance of the parameters evaluated cannot yet be considered established.

Although liquid systems were among the first to be studied, even the effects of thermal-neutron capture in the organic halogen compounds are not yet completely understood. As Willard asks, in a review contribution, "does radical formation occur by impact of neutral atoms on molecules of the medium, or by ion molecule reactions, or by neutralization of a solvent envelope that has been charged by charge transfer to the recoil atom following a vacancy cascade in the latter, or by the radiolytic effects of conversion electrons and Auger electrons or by the billiard-ball mechanism of impact with individual atoms?" Can liquids be treated using the Estrup–Wolfgang analysis or are they better interpreted using the thermal spike model that is useful with solids? Contributions, from several parts of the world, try to answer some of these questions. Nesmeyanov and Dzantiev and their collaborators investigated the departures from additivity of effects in two-component liquid mixtures.

A large part of the second volume deals with the effects in solids. Some 13 papers treat the primary effects, and another 13 cover post-irradiation phenomena. The irradiated solids behave as a matrix containing reactive species, possibly in many cases radicals. The results obtained are closely related to other studies on frozen free radicals, matrix systems, and the annealing of conventional radiation damage. Throughout these papers, one feels that something really important is just round the corner but is still managing to elude the investigators. The extension of these studies to include the behavior of ^{35}S in neutron-irradiated alkali chlorides, solids for which a wealth of physical data are available, may be a pointer as to the direction in which progress may be made.

Perhaps the most exciting contributions were the three papers dealing with the application of Mössbauer spectroscopy. This technique is clearly destined to provide very direct and important evidence on the chemical effects of nuclear transformations. Five of the last six papers are concerned with the chemical effects of beta decay. They provide a valuable addition to our knowledge of a part of this subject that has been neglected for several years. The final paper, from the USSR, introduces an entirely new and very interesting topic—the possibility of exploring fast chemical reactions by studying the behavior of muonium pseudo atoms in the system.

This collection of papers gives an accurate reflection of the state of worldwide activity in this branch of physical chemistry.

A. G. Maddock

University Chemical Laboratory
Cambridge, England

January 14, 1966

About the Reviewer: Alfred Gavin Maddock, Reader in Radiochemistry at Cambridge University and Fellow of St. Catharine's College, graduated at Imperial College, London, where his research was supervised by H. J. Emeléus. Sometime after completing his thesis, he was attached to the British equivalent of the Manhattan Project. After nearly four years in Canada, and participation in the founding of the Chalk River and, later, the Harwell laboratories, he returned to Cambridge University. His principal research interests revolve around the chemical effects of nuclear transformation, radiation damage in solids, and the chemistry of the heavy elements, especially protactinium.

The Physics of Elementary Particles. By H. Muirhead, Nuclear Physics Research Laboratory, Liverpool University. Pergamon Press, Long Island City, N. Y. (1965). 718 pp. $20.00

Today, the theory of elementary particles seems to be in a state similar to that of quantum theory in the early '20s. If one is ingenious in following the logic of field theory just far enough, and in departing from it at just the right points, he can calculate some numbers with very great accuracy, and others with fair accuracy, whereas still others either come out all wrong, or are not derivable at all. Theoreticians are displaying vast erudition and sagacity in proposing programs for developing a new theory; but all the programs published hitherto seem to fail somewhere, and one does not know whether any of them may eventually produce a complete and accurate theory. Furthermore, perhaps recalling the birth of quantum mechanics or of relativity, physicists sometimes predict that the theory of particles will not reach a satisfactory state until some radically new ideas have been introduced into it.

Meanwhile, students must understand particles by means of the theoretical ideas that are now available, and experimenters must know the predictions of existing theories, so they will appreciate how various future data may fit into, or alter, our present picture of the world. Muirhead has undertaken the difficult and necessary task of acquainting these people with the current data and theories on elementary particles.

In view of the complexity of his subject and its present tendency to change rapidly, he succeeds admirably in his exposition. Not only does he fully summarize the experimental data through 1963 (and mentions in a footnote the two-pion decay of K_2° that, in 1964, first threw doubt on CP invariance), he also does remarkably well in covering the vast body of relevant theoretical publications. After a brief introduction to particle physics, he devotes about a third of the book to relativistic quantum mechanics and the quantum theory of noninteracting fields. The next third of the book treats interacting fields; it includes a discussion of phase shifts, of the S matrix and covariant perturbation theory, of the symmetries of interacting fields, and of dispersion relations and Regge poles (though little is said about the bootstrap program—perhaps, because it is still a program rather than a theory). The rest of the book deals, in order, with electromagnetic, weak, and strong interactions, and includes an explanation of the SU_3 multiplet scheme and mass formula. Time, probably, did not permit any discussion of the "larger" unitary groups, and most of the work on combining internal and Poincaré groups has been published too recently to be included.

The high price is regrettable but, perhaps, unavoidable. However, it is not reflected in the inadequate job of proofreading and the failure to eliminate dangling gerunds; nor do the bibliographic references cite pages of the text as one might expect. Despite these flaws, both graduate students and senior physicists should find the book a valuable summary of the state of particle physics as it was early in 1964.

Ingram Bloch

Vanderbilt University
Nashville, Tennessee

March 8, 1966

About the Reviewer: Professor Bloch has been a member of the Department of Physics and Astronomy, Vanderbilt University, since 1948, with research interests in the quantum theory of measurements and the theory of particles. His formal academic training was at Harvard and The University of Chicago. Immediately following World War II, during which he served the Manhattan Project and the Technical Manpower Training Program, the reviewer was an associate of Professor Gregory Breit at Wisconsin University and at Yale.

Personnel Dosimetry for Radiation Accidents. Proceedings of a Symposium, Vienna, March 8-12, 1965. Published by the International Atomic Energy Agency (1965). 698 pp. $14.00.

This publication contains the proceedings of a symposium on the title subject, organized jointly by the International Atomic Energy Agency and the World Health Organization and held in Vienna in March 1965. The volume contains 50 papers (32 in English, 16 in French, and 2 in Russian) with abstracts in the four languages of the IAEA and discussions in English following individual papers. The range of subjects covered includes the role of dosimetry in the medical management of accident cases, measurement techniques for high-level doses, internal contamination, the assessment of dose itself, and the exchange of information about actual accidents and procedures used at a number of installations. Approximately one-half of the papers are devoted to measurement techniques, which include not only those for criticality accidents but also for high-level exposures from outer sources of radiation, such as accelerators.

This reviewer considers the publication of these proceedings to be a timely and valuable addition to existing literature on personnel dosimetry for two reasons. First, and foremost, contributions were made by persons who have devoted years to the problems discussed and who possess from firsthand experience a large share of what is known about accidents involving high-level exposure. Second, the volume represents a comprehensive state-of-the-art survey of accident dosimetry backed up by considerable detailed technical information. One finds papers on nuclear accident dosimeters, including various threshold detectors, on films, induced radioactivity in the body, phosphate glass, chemical systems, polymerization techniques, and thermoluminescent systems, as well as on new ideas such as the use of the diode radiation element. The papers appear to give a critical evaluation of the use and limitations of these systems. The state-of-the-art survey includes not only these technical subjects of dosimetry, but also such subjects as decontamination of patients and wounds and the administrative management of accident cases.

To this reviewer's knowledge, *Personnel Dosimetry for Radiation Accidents* stands alone as a sourcebook of information on the subject. Collected into one volume are descriptions and evaluations of the major accident systems, accident procedures in effect at various installations, and summaries of practical experience under actual conditions involving injury and loss of life. References cited in the papers give sources of additional information. The book is certainly to be recommended to anyone having a responsibility for or interest in radiation accidents. The participants should be congratulated, together with the IAEA and WHO, who recognized the need and sponsored the conference, for contributing an important addition to the literature on personnel dosimetry.

J. E. Turner

Oak Ridge National Laboratory
Oak Ridge, Tennessee

February 14, 1966

About the Reviewer: Dr. J. E. Turner has been with the Health Physics Division of ORNL since 1962. Following completion of his graduate studies at Vanderbilt University, he taught physics at Yale and was with the Atomic Energy Commission's Division of Biology and Medicine prior to coming to Oak Ridge. His interests, in addition to radiation dosimetry, have been in the interaction of radiation with matter and in the attachment of electrons to molecules.

Management of Radioactive Wastes. By C. A. Mawson, Van Nostrand Nuclear Science Series, D. Van Nostrand Company, Princeton, New Jersey (1965). 196 pages, 51 figures. $6.95.

This book, by C. A. Mawson, Head, Environmental Research Branch, Atomic Energy of Canada, Limited, is one of the second generation of books[1] devoted to the subject. Those of the first generation (1958-1961)[2-5] were all by

[1]C. P. STRAUB, "Low-Level Radioactive Wastes—Their Treatment, Handling, and Disposal," U. S. Government Printing Office, Washington, D. C. (1964).

[2]K. SADDINGTON and W. L. TEMPLETON, *Disposal of Radioactive Waste*, George Newnes, Ltd., London (1958).

[3]J. C. COLLINS (ed.), *Radioactive Wastes: Their Treatment and Disposal*, E. and F. N. Spon, Ltd., London (1960).

[4]E. GLUECKAUF (ed.), *Atomic Energy Waste. Its Nature, Use, and Disposal*, Interscience Publishers, Inc., New York; Butterworth & Co., Ltd., London (1961).

[5]C. B. AMPHLETT, *Treatment and Disposal of Radioactive Wastes*, Pergamon Press, New York (1961).