

## Book Reviews

**Elementary Particles.** By David H. Frisch and Alan M. Thorndike. D. Van Nostrand Co., Inc., Princeton, N. J., (1964). 152 pages, 42 drawings, 9 plates, index, bibliography. \$1.75.

*Elementary Particles* is a simple, nonmathematical exposition of the current state of elementary particle research intended for readers familiar with general physics. The authors say in their preface that familiarity with quantum mechanics is not necessary for understanding their book, but I think prospective readers should at least be acquainted with the notions of quantum mechanics. Physicists and chemists, regardless of their specialty, will have little difficulty reading this book, but other scientists may not be completely at home in the milieu of elementary-particle physics. The book should nevertheless have a very wide appeal: I recommend it to physicists trying to keep up with current events in their field as well as to students looking for an introduction to a new and rapidly evolving field and to scientific dilettantes in general.

The book has ten chapters. The first introduces the "unseen world" of the elementary particles and briefly summarizes the main features of atomic and nuclear structure. The second and fourth introduce the elementary particles themselves, giving their properties and their relations to one another. The third and fifth chapters deal respectively with the detection of elementary particles and the means for identifying them and measuring their properties. The sixth chapter is a short one dealing with elementary-particle reactions and mainly leading up to the phenomenon of "associated production." The seventh chapter describes the discovery of the antiproton. Chapter 8, in some ways the weakest, but by no means bad, deals with what may be learned from scattering experiments. Chapter 9 explains the conservation laws used in elementary particle physics, advancing from the better known laws of conservation of energy and momentum to the more esoteric laws of conservation of baryons, leptons, isotopic spin, and strangeness. The subject matter of this chapter is difficult and the authors are to be congratulated for their very clear and understandable text. The last chapter, Chapter 10, is entitled "Order

Out of Chaos?"; but lest the reader be misled by this title into believing that he will find out in the last chapter "who-dun-it," let him, in the authors' words, "be forewarned that in the end we won't be able to give any real explanation of why these particles exist or why they behave the way they do. We are at the farthest frontier of knowledge, and as yet no unifying theory is known."

The book is written in a lively, informal style that is a refreshing breath of wind in the stifling atmosphere of today's scientific prose. It is also well printed. The type is large and clear, and the major divisions of the book are clearly marked. The drawings are appropriate and well drawn, and the plates are interesting and give the reader a chance to examine the raw data of elementary-particle physics. The book has a soft cover, but I think one cannot expect more for \$1.75.

In sum, an excellent book that I heartily recommend.

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*About the Author: Lawrence Dresner has been a physicist at the Oak Ridge National Laboratory since 1954. His work, until recently, has been in the fields of reactor and nuclear physics. He is currently working on the problem of purifying salt water.*

**Production and Use of Short-Lived Radioisotopes from Reactors, Volumes I and II.** Proceedings of a Seminar, Vienna, (5-9 November, 1962). Vol. I, 433 pp; \$8.50. Vol. II, 272 pp; \$5.50.

While the title of these proceedings might suggest that the information is only of importance to users of short-lived isotopes, the extensive discussion of applications is in no way limited by the life-time of the isotope. As a result, these proceedings will be of value to anyone interested in isotope applications because they contain both excellent review papers and papers that report

new work on isotope applications in industry, research, and biology and medicine. It is interesting to note that no applications were reported that utilize rapid decay as part of the *principle* of the application.

These Proceedings contain an excellent presentation of the state of the art on the production and use of short-lived radioisotopes, beginning with comprehensive review papers and extending through specific applications in industry and biology and medicine. The Proceedings are ostensibly directed toward increasing the usefulness of the many small research reactors now in operation throughout the world which can bring the high specific activity of short-lived radioisotopes within the reach of many groups. However, the material goes beyond this to describe systems for rapid handling of irradiations in large reactors and a rather complete description of 'milking' techniques for providing short-lived isotopes from long-lived parent isotopes at locations quite remote from any reactor. In applications where physical tracing is sufficient, and this includes the bulk of industrial or engineering tracing applications, short-lived isotopes from milkers can provide many advantages over long lived tracers, not the least of which is the ability to obtain many millicuries of radioactivity from a one-millicurie source.

Part I, Volume I, Production and Preparation of Short-Lived Radioisotopes, begins with an excellent introductory paper by L. G. Stang, Jr. on the fundamentals of radioisotope production reactions and concludes with a working description of a number of milking techniques. The papers that follow this describe in considerable detail the facilities for short-lived radioisotope production and preparation in a number of countries. Details are given on rapid introduction and removal techniques and on rapid chemical processing steps for separation of short-lived isotopes. W. W. Meinke (University of Michigan) asserts that, "It is definitely possible to make separations routinely on all types of samples on time scales of a few minutes". While he does not present separation details in his paper, he does include a comprehensive bibliography. Douis and Valade (Centre d'Etudes Nucléaires) present specific processing steps for several radioisotopes.

Part II, Volume I, Preparation and Application of Short-lived Radioisotopes, contains some papers where short-lived isotopes have been used in applications where longer-lived isotopes have been conventionally used. A particularly interesting paper by Nelson and Kraus (ORNL) describes the use of radioisotopes (not necessarily short-lived) for the measurement of physico-chemical constants such as low solubilities and

liquid diffusion coefficients. Each of the papers in this section contains detailed information on rapid preparation and separation techniques.

Part III, Volume I, Industrial Applications, contains three review papers providing an excellent coverage of industrial applications. It is again pertinent to remark that these applications are not technically restricted to the use of short-lived isotopes, though their use does circumvent the practical problem of long-term contamination of process products. Extensive bibliographies are appended to provide specific references. The balance of the papers are rather specific and some are quite good. The subject matter ranges from chemical engineering studies of residence times, liquid and solid transport and mixing studies to labelling techniques, metallurgical tracing applications, leak detection, hydrology and isoactivity profiles in the ocean.

Part IV, Volume II, Activation Analysis, provides a description of activation-analysis techniques with emphasis on the experimental details necessary to separate and measure short-lived activation products. Several survey papers serve to illustrate the broad range of analyses available when short-lived activation products can be identified and measured.

Parts V and VI, Volume II, Applications In Medicine and Biology, respectively, present nine specific applications of short-lived radioisotopes for diagnosis, therapy and research. The short-lived isotopes have particular practical value in these fields because of the ability to obtain diagnostic information with a minimum of patient exposure.

It is interesting to note that there appears to be much less reticence in European and Asian countries in the use of short-lived isotopes in industrial and environmental tracing than in the United States. Perhaps this is in part due to our attempt to protect the public by providing a legal basis as in Title 10 Exempt Concentrations. These concentrations unnecessarily restrict the use of short-lived isotopes by giving values for short-lived concentrations, leaving ambiguous the question of when these concentrations are to be measured.

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*About the Reviewers: Each of the reviewers is a member of the technical staff of the Research Triangle Institute, Durham, North Carolina and each arrived there following broad experiences in*

research, administrative and academic assignments. *Ralph Ely, Jr.*, who is active in the Society's Isotope and Radiation Division, spent a number of years in research and development at Westinghouse and at Nuclear Science and Engineering Corporation following completion of his graduate work at Pittsburgh. *Robin Gardner*, with a Ph.D. from Penn State, was at ORNL and at ORINS, directing at the latter, a program of engineering applications of isotopes. After completing graduate studies at MIT, *Harold Richter* was at the US Naval Radiological Defense Laboratory and at Nuclear Science and Engineering Corporation where he developed new methods of radiochemical analysis and of low-level radioactivity techniques.

This copious background of experience germane to the topic makes their review even more meaningful.

**Technique of Inorganic Chemistry, Volume One.** Edited by Hans B. Jonassen and Arnold Weissberger. Interscience Publishers, New York and London (1963). 268 pp. \$9.50.

This book is one of a series on inorganic chemistry intended to be companion volumes to the well known *Technique of Organic Chemistry* edited by A. Weissberger, et al. Each of the six chapters in Vol. I of the inorganic series covers a different subject and is written by a different author. In general, the authors have competently met the objectives established by the editors: "A treatment of the theoretical background and a critical evaluation of the merits and limitations of the techniques are included in each chapter".

The first chapter, "Determination of Formation Constants" is written by Sture Fronaeus, The University of Lund, Sweden. This chapter (33 pp., 84 ref.) is well organized and is written in a scholarly manner. Since the author relies heavily on mathematics to tell the story, the chapter is not written for the casual reader but for those who are interested in a basic understanding of the described experimental techniques.

Alexander I. Popov, Michigan State University, is the author of the second chapter, "Techniques with Nonaqueous Solvents". This chapter (61 pp., 164 ref.) will serve as a general introduction to techniques used in non-aqueous studies and as an excellent source of references to the literature. The author's goal was "... to cover only some rather broad general areas of work with non-aqueous solvents and to illustrate the generalizations with a few specific examples". The author met these objectives; however, the reviewer felt that the discussions of the use of non-aqueous chemistry in synthetic work was weak and the

discussions on the criteria for solvent purity was inadequate.

The third chapter "Fused Salt Techniques" (47 pp., 216 ref.) is co-authored by John D. Corbett and Frederick R. Duke (Iowa State University). The authors discussed the subject under the headings of (1) General Apparatus and Methods, (2) Preparation and Purification of Materials, (3) Equilibrium Properties of Fused Salts and (4) Dynamic Properties (electrical conductivity, and ionic transport) of fused Salts. A major section (21 pages) of the chapter was used to discuss "Equilibrium Properties of Fused Salts". This section is devoted to discussion of experimental methods primarily pertaining to condensed phase equilibrium, cryoscopy, vapor pressure and vapor equilibria, calorimetry, density, surface tension, potentiometry, and other equilibrium studies. In a few instances, the authors describe the equipment but fail to describe the method adequately; overall, however, the chapter is well written and will serve as an excellent guide to fused-salt techniques.

Spectral measurements in high-pressure systems are covered in the fourth chapter. The bulk of the chapter (15 pp., 38 ref.) is written by W. W. Robertson, University of Texas. A section on "Apparatus for Spectroscopic Measurements Above 10 Kilobars" (5 pp., 23 ref.) is written by H. G. Drickamer. This chapter is well written and the diagrams of high-pressure seals, windows, etc. are clearly drawn and described. The subject matter is primarily devoted to high-pressure equipment design as indicated by the subject headings: (1) Window Designs, (2) The Strength of Window Materials, (3) Pressure-Transmitting Fluids, (4) Simultaneous High Pressures and High Temperatures, (5) Intensity Measurements and (6) Apparatus for Spectroscopic Measurements Above 10 Kilobars.

In the fifth chapter (27 pp., 83 ref.), "The Use of Electric Discharges in Chemical Syntheses" is discussed by William L. Jolly, University of California. The main subject headings are Glow Discharges and Arcs. The chapter is well written and the author clearly indicates the potential and limitations of electrical discharges in chemical synthesis. The chapter is devoted primarily to discussions of experimental equipment and techniques for the use of electrical discharges in laboratory synthesis.

The last chapter, "Differential Thermal Analysis", is written by W. W. Wendlandt, Texas Technological College. In this chapter (44 pp., 162 ref.), the major subjects discussed are: (1) Theory of Differential Thermal Analysis, (2) Instrumentation, (3) Factors Affecting Experimental Results, (4) Quantitative Aspects of Differential