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Introduction to Experimental Nuclear Physics. By R. M. Singru. John Wiley and Sons, Inc., New York (1975). 162 pp. \$6.95.

Texts on experimental work in the nuclear field can be divided up into at least four categories. These are concerned with measurements in high-energy physics, lower energy physics measurements attempting to understand the various states and properties of matter, experiments involving the handling and application of radioisotopes, and experiments associated with reactor physics and design. Singru's book falls into the second category and is aimed at MS students who have had basic nuclear physics. It is intended to be an experimental companion piece to theoretical texts at this level. The reactor engineer will find little comfort or assistance from the text. There are no reactor experiments described.

The book is concerned with experimentation to determine the fundamental states of matter. The indicated parameters to be measured are energy, spin, parity, the magnetic dipole, the electric quadrupole, and particle lifetime. The principal tool is usually a spectrometer of some sort, and the output generally consists of interpretation of some form of multichannel analyzer. Emphasis is on techniques involving nuclear decay schemes.

In writing a text on experimentation, there are again at least two approaches. The first is to write a laboratory manual that describes the apparatus and procedure in step-by-step detail for each specific experiment. The second approach is to present broadly the theory and the type of apparatus that could be used and to leave the details to the experimenter. Again, Singru selects the second path. Generalized apparatus configurations are shown in block diagram form, and no procedures are given. Almost no detailed circuitry is presented, and breakdown of the block boxes into detailed electronics is not attempted.

This is a small book and the first half of it is spent in a review of nuclear physics and basic instrumentation for measuring various types of radiation. The first two chapters cover nuclear properties, nuclear decay, and a summary of the various kinds of conventional low-energy nuclear reactions. The third chapter is concerned with the interaction of radiation with matter and reviews the absorption of alpha and beta particles and gamma rays in matter. The treatment is simplified and standard.

Similarly, nuclear radiation detection is treated in the classical manner. In describing gas-filled counters, for example, the exposition is a condensation of Price (*Nuclear Radiation Detection*, 1958) and Korff (*Electron and Nuclear Counters*, 1955). The section on solid-state detectors is also short but does present some background on junction and surface barrier detectors.

The remainder of the book concentrates on various spectrometry experiments that have been available in the field for a number of years. Alpha, beta, and gamma spectroscopy setups are blocked out, and typical spectra for various radioisotopes are presented. The book concludes with a section on analyzing the data from spectroscopic

experiments, and a final chapter covers special measurements such as positron annihilation studies, the Mossbauer effect, and perturbed angular correlations.

I liked the book as a quick summary of the field, but would have preferred considerably more detail on the electronics and the methods of measurement. For example, new techniques such as fast coincidence circuits that use crossover detectors are just barely mentioned in the book. It would also have been useful if there had been more comparison, pro and con, of the various means of measurement and some indication as to the relative difficulties and accuracies of comparative experiments.

And in conclusion, a pet peeve—after an author has spent so much time writing a book, it is a shame to have it end up on poor quality paper.

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About the Reviewer: M. A. Schultz is a professor in the Nuclear Engineering Department at The Pennsylvania State University, where he teaches nuclear laboratory courses. He is the author of two laboratory manuals for undergraduate nuclear instrumentation and, as an early pioneer in the reactor field, wrote the first definitive text on Control of Nuclear Reactors and Power Plants.

The Chemistry of Americium. By Wallace W. Schulz. TID-26981, U.S. Energy Research and Development Administration, Technical Information Center (1976). 291 pp. \$6.00.

This book is an extremely useful compilation of the descriptive chemistry of americium. It is the author's stated intention to collect and review in one place the essential features of americium chemistry. As such, the book fills an important need because it presents for the first time a comprehensive treatment of material that would otherwise be found only in a diverse assortment of references, many of which are not easily available to all segments of the scientific community. Americium chemistry is delineated here within the traditional "occurrence-properties-compounds-uses" framework. The subject matter is well ordered for ready reference, and the various topics are treated critically, thus providing the reader with insight of the subject matter not generally found in literature reviews. In addition, this work is useful as a reference source, because each chapter contains an extensive bibliography augmented by a collateral reading section at the end of the first chapter. The first 22 pages of the book are devoted to the discovery of americium, atomic and nuclear properties, and collateral reading (131 references). This is followed by 23 pages on production and uses (198 references), 75 pages on chemistry in aqueous solution (248 references), 62 pages on metal, alloys, and compounds (206 references), and 95 pages on recovery, separation, and purification (382 references). Both author and subject indexes are provided.

Chapters 1 and 2 are primarily concise summaries of the atomic and nuclear properties of americium and the production and uses of americium, respectively. Due to the extensive use of tables and figures, a considerable amount of information is summarized in these chapters.

Chapter 3 describes americium chemistry in aqueous

solution. This chapter is conveniently divided into eight sections:

1. oxidation states
2. thermodynamic values
3. electrode potentials
4. autoreduction effects
5. disproportionation
6. kinetics of oxidation-reduction reactions
7. solution absorption spectra
8. complexes of americium ions.

Significant aspects of each of the oxidation states of americium are described, including the (VII) state, which has only recently been reported. Autoreduction of the higher oxidation states of americium by species produced by alpha radiolysis of water and the disproportionation reactions of Am(IV) and (V) in various media are discussed. The kinetics of oxidation reduction reactions are thoroughly reviewed, as are solution absorption spectra. A comprehensive number of spectra are presented in 20 accompanying figures. The section dealing with complexes of americium ions includes an unusually complete table of americium complexes with inorganic and organic ligands. Both the completeness and the table format are to be commended.

Chapter 4, "Metal, Alloys, and Compounds," describes the preparation and properties of americium metal and discusses known alloys and intermetallic compounds. The last section in this chapter presents a thorough and useful resume of the inorganic and organic compounds of americium. The known inorganic compounds for which compositions are established, along with some of their properties, are conveniently listed in a table for ready reference. The accompanying text describes other properties of the compounds and methods of preparation. A few inorganic compounds whose compositions have not been definitely established are also mentioned.

The final chapter describes americium recovery, separation, and purification. Once again, the author presents a very thorough treatment of the subject. The emphasis in this review is on aqueous process methods that have been or are currently being used to recover and purify gram-to-kilogram amounts of americium; however, methods used

primarily for analytical purposes or tested only on a laboratory scale are cited. The chapter is divided into sections that deal consecutively with pyrochemical, precipitation, solvent extraction, ion exchange, extraction chromatographic, and miscellaneous processes. In addition to discussions of the process chemistry and process procedures employed, this chapter presents the reader with an up-to-date description of the use and status of each process. Many of the processes are graphically illustrated with descriptive flowsheets; it seems likely that virtually all published flowsheets are included. The chapter also contains a large number of tables and figures that present data pertinent to the various process operations.

This book presents the first comprehensive review of the existing literature on the chemistry of americium. As a review, it is not intended to provide an in-depth treatment of the subject matter; however, the author is to be commended for his thoroughness as well as for the excellent bibliography that accompanies the text. The narrative style used by the author is interesting and easy to read, and the reader will find that this book will provide him with an unusually thorough knowledge of the chemistry of americium without further reference to other information sources.

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About the Reviewer: Milton H. Lloyd (BS, MS, chemistry, Creighton University) is a senior research chemist at Oak Ridge National Laboratory (ORNL). He has been associated with the Transuranium Element Production Program at ORNL since the program's inception in 1959, and has served as group leader in charge of process development and final product isolation and purification. At the present time, Mr. Lloyd is a manager in the Pilot Plant Section of the Chemical Technology Division in charge of process research and development. His current research interests include plutonia sol-gel processes for the preparation of advanced reactor fuels and chemical studies of plutonium behavior in reactor fuel reprocessing and waste solutions.