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Book Reviews

The Solvent Extraction of Metal Chelates. By J. Stary. Pergamon Press, The Macmillan Company, New York, (December 28, 1964), 240 pages, $8.50.

This book is devoted to the theory of metal-chelate solvent extraction and its application in analytical, inorganic, and nuclear chemistry and technology. The first three chapters deal with the theoretical aspects of metal chelates. The fourth chapter is also theoretical in nature despite the somewhat misleading title of "Analytical Applications." In this chapter Prof. Stary discloses how to calculate from the extraction constants of metal-chelate systems the best conditions for the separation of many metals. He also describes the recent, highly selective method of substoichiometry which is finding application in trace analysis chemistry. In this technique, less than stoichiometric quantities of chelate formers are used in contrast to the generally accepted large excesses of these reagents. For a successful determination it is necessary to isolate exactly the same amount of the element in question from solutions of standard and sample alike in which the element is present in different amounts. Equal amounts of organic reagent for producing an extractable chelate are added with the stipulation that these amounts are smaller than that which corresponds stoichiometrically to the amount of element present. Quantitative isolation is not required, which is a great analytical advantage. Stary is largely responsible for this important addition to analytical techniques, which makes solvent extraction even more selective. He presents the theory of substoichiometry in a clear, concise manner.

The remaining chapters, approximately 75% of the book, are given to systems in which the chelate formers are described by classes, and to selective extraction procedures for individual metals. It is this fraction of the book that is of most interest and concern to process and analytical separations chemists.

Perhaps the simplest statement, yet the most informative to prospective purchasers of the book, to make concerning this work is that it will undoubtedly find wide acceptance and be equally widely used. In this respect its arrival will be as welcome as that afforded to Morrison and Freiser's *Solvent Extraction in Analytical Chemistry* (J. Wiley & Sons, New York, 1957). Stary's book is useful. He has gone to much trouble to make his information easily and readily accessible. This is a refreshing approach in contrast to some authors who seemingly like to have the reader struggle a bit to get the information desired. The tables in Chapter 5, which delineate the optimum conditions for extraction for each metal ion by a specific reagent, are exemplary. In Chapter 6, a detailed extraction procedure is given by element. The chapters are nicely complementary to each other.

The references signify the truly cosmopolitan character of research in this field. The works of the leading proponents of chelate solvent extraction from the Western and Eastern world are well represented. In short, the references are as complete as humanly possible. Stary has given us a book that will now serve as the definitive work in the solvent extraction of metal chelates.

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About the Reviewer: J. C. White is the Assistant Director in charge of research and development of the analytical Chemistry Division of the Oak Ridge National Laboratory. He has been a member of the staff of ORNL since receiving his PhD degree from Ohio State University in 1950. His research interests have been in separations by solvent extraction and the analysis of molten salts.

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Radioisotopic Power Generation. By William R. Corliss and Douglas G. Harvey. Prentice Hall, 304 pages, $14.75.

As indicated in the preface, the authors had two objectives in mind: one was to bring together in a book the widely varying subject matter from the different disciplines involved in the engineering of radioisotopic power generators; the other was to record and preserve some of the fascinating history of radioisotopic generator development. Authors Corliss and Harvey have indeed achieved their goals; accordingly, as they also state, the book is primarily descriptive rather than tutorial in character.

The book is divided into two parts: Part A entitled "General Design Considerations" and Part B entitled "Specific Radioisotopic Generators." Each part contains five chapters, with 149 pages in Part A and 105 pages in Part B. The authors devote another 30 pages to two appendices and a bibliography. The bibliography is divided into ten sections, one for each chapter, and lists 237 references. In appendix 1, the authors tabulate data on 36 radioisotopes selected on the basis that the half-life is between 100 days and 100 years, the specific power is greater than 0.1 w/g, and the emission is not pure or nearly pure gamma radiation. Included in the tabulation are particulate disintegration energies and the average energy available for power production. Appendix 2 is a glossary of specialized terms.

The book contains a large number of illustrations and tables. Of the 199 figures, nearly 40% are photographs furnished by organizations involved in the development of

radioisotopic power generators. The book is without a list of illustrations or a list of the 41 tables. It is probably of interest to many engineers to list here the titles of tables in each of the chapters of Part A:

Chapter 1 "Introduction to Radioisotopic Power Generation"
- 1-1 Historical summary of the Development of Radioisotopic Power Generators
- 1-2 Characteristics of Some Radioisotopic Power Generators
- 1-3 Radioisotopic Generator Performance Factors
- 1-4 Power Plant Environmental Constraints
- 1-5 Power Plants that Compete with Radioisotopic Generators
- 1-6 Classes of Space Missions

Chapter 2 "Radioisotopic Fuels"
- 2-1 Types of Radioactive Decay
- 2-2 Radioisotopic Fuels
- 2-3 Availability and Costs of Selected Radioisotopes

Chapter 3 "Nuclear Safety"
- 3-1 Maximum Permissible Concentrations of Radioisotopic Fuels
- 3-2 Maximum Permissible Exposures to External Radiation
- 3-3 Physical Forces Important to Safe Design
- 3-4 Accident Frequency Rate for Generator Shipment
- 3-5 Forces Impressed During Accidents on Space Missions
- 3-6 Hypothetical Generator Safety Engineering Data
- 3-7 Scout Booster Data
- 3-8 Hypothetical Mission Staging Data
- 3-9 Impact Range for Most-Probable Aborts
- 3-10 Definition of Terms in Fallout Equation

Chapter 4 "Energy Conversion"
- 4-1 Comparison of Dynamic Converters
- 4-2 Energy Conversion Matrix

Chapter 5 "Generator Design Principles"
- 5-1 Typical Shock and Vibration Loads for a Space Generator During Launch
- 5-2 Some Major Design Decisions and Their Implications
- 5-3 Fuel Capsule Structural Materials
- 5-4 Properties of Thermal Insulating Materials
- 5-5 Radiation Tolerance of Electronic Circuit Components
- 5-6 Radiation Tolerances of Electronic Equipment

In Part B, there are chapters describing surface, undersea, and space generators. One chapter discusses nuclear batteries, which the authors define by exception as those radioisotopic power generators that do not use heat engines in the energy conversion process. A final brief chapter mentions some advanced concepts. Some generator details have been intentionally omitted for security reasons particularly in the case of space generators. The first radioisotopic-powered electric generator in space was carried by Transit IV-A, a satellite launched by the United States on June 29, 1961. This event represented an important milestone in the U.S. space program. Apparent lack of Soviet activity in this field leaves the U.S. with a technological lead.

This book fills a gap in the technical literature. It is recommended particularly to application engineers concerned with power sources—radioisotopic or not—in the electrical power range from a few watts to a few kilowatts.

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About the Reviewer: Richard Madey is Professor of Physics and Chairman of the Physics Department at Clarkson College of Technology in Potsdam, New York. He received his PhD from the University of California at Berkeley in 1952 and a BEE degree from Rensselaer Polytechnic Institute in 1942.

Prior to his present position, he was Chief of Applied Physics at Republic Aviation Corporation. Before joining Republic in 1956, he conducted research in high-energy physics at the University of California Radiation Laboratory in Berkeley from 1947 to 1953 and at the Brookhaven National Laboratory from 1953 to 1956. He served in the US Navy from 1944 to 1946 after spending fifteen months with the Allen B. DuMont Laboratories.

Numerical Methods of Reactor Analysis. By Melville Clark, Jr. and Kent F. Hansen. Academic Press, New York, N. Y., 340 pp., $10.50.

Clark and Hansen have written a graduate-level text designed to be used in a one-semester course on the numerical methods used in the solution of various forms of the neutron transport equation. The subject matter is the mathematics underlying difference approximations to the equation; programming and details of codes in existence are not discussed to any extent. Hence, the book has rather general interest.

The student who studies from this book should be well prepared in differential equations, matrix algebra and reactor physics. He will also need to come to the course well motivated, that is to say, he must already appreciate that many problems in reactor technology can be solved only by recourse to numerical techniques. The student will find that he must stay awake during the lectures that accompany the book and work out the assigned problem because the writing is quite concise, making parts of the book rather heavy going.

By expending the amount of work that a mature graduate student should, the student will come away from a course based upon this book with somewhat more than the title suggests. This is because the authors have used the reasonable approach that the equations used in solving the reactor equations are simply examples of more general classes of differential equations. In fact, the first half of the book could be well the first half of a book entitled "Numerical Methods of _____" (fill in the blank). This is all to the good, particularly as one might legitimately raise the question as to whether it might not be better to have a student study numerical methods as a general mathematical tool instead of emphasizing a particular application. In the first three chapters that cover the general subject of difference equations and their numerical solution, there are good discussions on the convergence and stability of numerical solutions, truncation error, and on the analytic solution of difference equations. This latter is quite welcome because many of us who use computers often neglect to seek analytic solutions and it is through the