avoided. Whether or not such schemes can be made practical and economically competitive is left to the reader's imagination. Chapter 12 discusses radiological aspects of fusion reactors such as the expected radioactive material inventory in a given fusion plant and the shutdown afterheat problem.

Chapter 13 devotes 37 pages to design aspects of toroidal and mirror reactors. This chapter was, unfortunately, written just prior to the publication of the first generation of complete reactor designs developed at the national laboratories, the University of Wisconsin, and General Atomic Company. Therefore, the book does not really display any real reactor design study results, but rather presents early parameter studies used to help determine a reactor operating point. Several generations of different reactor designs have now been developed, and the subject of reactor design has considerably advanced over that briefly begun in this text.

Chapter 14 (53 pages) treats radiation damage to fusion reactor materials; it is a very good introduction to this important topic. The remainder of the text treats rather briefly some heat transfer problems and discusses the differences between some reactor concepts.

I particularly liked some parts of this interesting book, i.e., the chapters on neutral beams and the radiation damage of materials. There are, unfortunately, some pages completely filled with equations and formulas that will put off all but the most devoted reader, and some of the figures employed print too small to read. Treating a rapidly changing subject is difficult, and Kammash has done a creditable job in bringing much material together. Where his text treats fundamental physics and nuclear science, it is at its best.

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About the Reviewer: Robert A. Gross is professor of engineering science and a member of the Mechanical and Nuclear Engineering Department at Columbia University, where he founded the Plasma Laboratory in 1960. Following completion of his graduate studies at Harvard in 1952, Dr. Gross was first engaged in aerospace and combustion research. He is a Fellow of the American Physical Society and of the American Institute of Aeronautics and Astronautics.

Determination of Uranium and Plutonium in Nuclear Fuels. By Herbert Sorantin. Verlag Chemie, Weinheim (1975). 288 pp.

This book is the fifth volume of the series "Kernchemie in Einzeldarstellungen," and, following a general trend, the third to be written in English. At the time of writing this book (1972), the author indicated economic reasons in addition to safety (criticality) considerations as the main motivations for high-precision analysis of fuel (chemical composition, content of fissile material, nuclear purity control). In the meantime, the price of nuclear fuel material has increased, its availability has become restricted, and the prospects of a "plutonium economy" have become a public concern and target for opponents of nuclear energy. A worldwide nuclear material safeguard system is being established. All these reasons justify a compilation of our knowledge on the determination of the most important components of nuclear fuel, namely, uranium and plutonium.

The author did not intend to present a handbook of fuel laboratory practice but rather a review of possibilities (~3000 references). The book is divided into two main parts, covering the analysis of nonirradiated fuel (or "fuel elements," as indicated in the corresponding chapter headings) and irradiated fuel (elements), respectively. The chapters of both parts follow a similar, although not completely identical, scheme, e.g., sampling, dissolution, separation, and determination of the elements or their compounds. Nondestructive examination of fuel elements is included. Special emphasis is given to the most important methods of separation (solvent extraction, ion exchange, extraction chromatography) and of elemental determination (volumetric, electrochemical, spectroscopic), as well as to techniques for the measurement of isotopic abundance and burnup.

In general, the problems are clearly outlined; many solutions are offered, and their principles and application limits are described. Schematic illustrations of many instrumental methods are presented, and an overwhelming amount of information is summarized in the tables. The reader is frequently referred to reviews, and references are compiled at the end of each subchapter.

A few comments might be made: The division of the book into analyses of nonirradiated and irradiated fuel (elements) is not always consistently followed: Although the "nonirradiated fuel" part includes sampling, purity control, dissolution, fabrication control, and nondestructive examination of plutonium-containing (fast) reactor fuel, the separation and determination methods (more than one-third of the book) are restricted to uranium; on the other hand, plutonium analysis is discussed mainly in connection with irradiated fuel.

Readers might have difficulty in finding the established practical methods among the large number of possibilities described, might be misled by the sometimes unreflected use of "fissionable" and "fissile," of "fuel" and "fuel elements" as synonyms, or might be confused by a lack of correspondence between some references in the text and in the lists. There are a few misprints in formulas and nuclide symbols and misspellings of authors' names. The reviewer must admit that he found it difficult to understand a sentence in the jacket text: "Since the price of the spent nuclear fuel is a significant item in cost calculations, it is important to know the content of the fission products both in non-irradiated and in burnt-up fuel elements."

This book of Sorantin can be recommended as a comprehensive review of the literature on uranium and plutonium determinations up to the early 1970's. It is most helpful in the hands of experienced workers, used to "Selected Methods," to remind them of other analytical possibilities and some of their pitfalls.

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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 quadrapole, 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 black 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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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