Book Reviews

Nuclear and Radiochemistry, 3rd ed. By G. Friedlander, J. W. Kennedy, E. S. Macias, and J. M. Miller, Wiley-Interscience Publishers, Inc., New York (1981). 684 pp. $29.50 softbound; $42.00 hardbound.

At this reviewer's university, where various texts have been used in our undergraduate lecture/laboratory course in radioisotope techniques from time to time during the past 15 years, only one text has been used in our graduate lecture course in nuclear and radiochemistry–the second edition of the book by the same name, that edition authored by Friedlander, Kennedy, and Miller. The three of us on the faculty here at University of California-Irvine who rotate teaching this graduate course have continued to use the second edition as the text for the course very simply because we have felt it was definitely the best book available for this course. However, the second edition was published some 17 years ago, in 1964, and hence in recent years we and others began to feel concern over the fact that the book was steadily becoming more and more out-of-date, and even contained nothing at all on some important recent developments in the field. It became increasingly necessary to supplement the text with more recent material, in the course lectures. All of us were, therefore, strongly hoping that a thoroughly updated third edition would be forthcoming soon, and that it would maintain the high standard of excellence of the second edition. Fortunately, in the opinion of this reviewer, our hopes and expectations have been answered abundantly in the now available third edition. It should enable this text to continue in its eminent position in the field for another decade or more.

The two living authors of the third edition (Joseph Kennedy died many years ago, and Julian Miller a few years ago) have essentially maintained the structure and content of the second edition, but have at the same time updated the theoretical treatments and references, and have expanded the book from its former total of 585 pages to a total of 684 pages. The new text includes the same 15 chapters as before (two with their titles changed somewhat), but the sequence has been significantly rearranged. The 15 chapters of the third edition, arranged in sequence, are: "Introduction," "Atomic Nuclei," "Radioactive Decay Processes," "Nuclear Reactions," "Equations of Radioactive Decay and Growth," "Interaction of Radiations with Matter," "Radiation Detection and Measurement," "Techniques in Nuclear Chemistry," "Statistical Considerations in Radioactivity Measurements," "Nuclear Models," "Radiochemical Applications," "Nuclear Processes as Chemical Probes," "Nuclear Processes in Geology and Astrophysics," "Nuclear Energy," and "Sources of Nuclear Bombarding Particles." This appears to this reviewer to be a fairly logical sequence, except that the chapter on "Statistical Considerations in Radioactivity Measurements" might more logically precede the chapter on "Techniques in Nuclear Chemistry," and the chapter on "Sources of Nuclear Bombarding Particles" might more logically follow right after the chapter on "Nuclear Reactions" (instead of being the last chapter).

A few specific changes of note may be cited. In the Introduction, the outlines of the uranium, thorium, and actinium decay chains have been condensed (the earlier version was better). In the chapter "Atomic Nuclei," a newer and more accurate semiempirical nuclear binding energy equation has been introduced. In the chapter "Radiation Detection and Measurement," the section on semiconductor detectors has understandably been expanded considerably. Two new appendixes have been introduced, but a useful previous one (listing atomic thermal-neutron absorption cross sections) has been deleted. Appendix D is a thoroughly updated Table of Nuclides, prepared by V. S. Shirley and C. M. Lederer from the Seventh Edition of the Table of Isotopes; it now includes mass excesses (in million electron volts) instead of atomic masses (in atomic mass units), and both spin and parity assignments instead of only spin values. Compared with the previous edition, the third edition contains not only 17% more pages, but 37% more equations, 41% more references, 11% more exercises, and 50% more figures–but 14% fewer tables; of the 15 chapters, 5 have been decreased in length (by an average of 19%) and 10 have been increased in length (by an average of 35%).

From the standpoint of this reviewer (a radiochemist specializing in nuclear activation analysis), the third edition still has a number of shortcomings that were also present in the previous edition: (a) the emphasis on theory diminishes the space available for discussion of important nuclear applications, (b) the emphasis on nuclear chemistry results in a diminished treatment of radiochemistry, (c) the only form of the nuclear activation analysis method discussed even briefly is that with thermal neutrons (forms involving epithermal, fission-spectrum, and 14-MeV neutrons–or charged particles or bremsstrahlung–are either not mentioned or only mentioned with no discussion), and the uses of delayed neutrons, prompt gamma rays, reactor pulses, ^{252}Cf sources, and cyclic activations in nuclear activation analysis are not discussed, (d) neutron radiography is not discussed, (e) autoradiography and isotope dilution analysis methods are only treated briefly, and (f) there does not appear to be any specific mention or discussion of cadmium ratios or resonance integrals.

Despite these minor shortcomings, there is no disputing the fact that the authors have done an excellent job of updating the previous edition, and that the third edition of *Nuclear and Radiochemistry* will continue the excellent reputation and wide acceptance of the previous edition. It should continue as an outstanding choice as a textbook for advanced courses in this field, also as an essential, frequently consulted reference work for those engaged in the fields of nuclear chemistry, radiochemistry, and the applications of nuclear methods in many fields.

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About the Reviewer: Vincent Guinn is professor of radiochemistry at the University of California-Irvine, where for more than a decade he has taught courses in radiochemistry, nuclear chemistry, nuclear activation analysis, and forensic chemistry and where, with his students at all levels, he conducts research in these fields. Previously he pursued similar interests at Shell Development and at General Atomic. Dr. Guinn did his graduate work at Harvard under Professor Kistiakowsky. He is a Fellow of the American Nuclear Society and has been chairman of its Isotopes and Radiation Division.

Nuclear Reactor Engineering, 3rd ed. By Samuel Glasstone and Alexander Sesonske, Van Nostrand Reinhold Company, New York (1981). $39.50.

The long and distinguished contribution to nuclear engineering education of Samuel Glasstone and Alexander Sesonske has additional lustre with the publication of the third edition of *Nuclear Reactor Engineering*. A large number of the nuclear engineers and scientists who received their education during the sixties and seventies learned the basics from the first and second editions. Many of us in academia attempted to use the second edition (circa 1967) by updating and extending the material far beyond the half-life usually assigned to a basic textbook in a changing technical field. The third edition, while retaining format, style, and many of the figures and illustrations of its predecessors, has been extensively rewritten with a clear and consistent emphasis on those topics directly related to the light water reactor power plant and the fast reactor power system. Gone are the interesting reactor concepts such as sodium-graphite and organic-cooled reactors, the thermal test reactors, and pulsing systems. Even the Fast Flux Test Facility receives only a paragraph in a section devoted to the liquid-metal fast breeder reactor as a nuclear steam supply system. The current real-world problems are addressed appropriately throughout the text, and a new chapter, "Nuclear Reactor Safety," includes much of the post-Three Mile Island impact on operating systems. Lessons learned are not tacked on as an afterthought, but are carefully tied into appropriate sections of the text. Although two chapters have been eliminated, and a smaller type case is used, the number of pages remains essentially the same. There are few topics included that are of minor significance; I would have difficulty deciding what to omit. Curricula using the new edition may wish to devote three semesters to adequately utilize the material.

As the authors note in the Preface, the International System of Units (SI) has been used throughout. Some of us oldtimers will encounter a few rough spots adjusting to neutron flux in $n/m^2 \cdot s$ and plants operating at pressures of 15.5 MPa. Most engineering students use both systems and should be able to make the transition from the SI classroom to today's non-SI control rooms. Problems have been revised and updated. The material seems to be relatively free of errors and the authors have been careful to use current references throughout.

The development of basics in the early chapters is unchanged. Doppler broadening is first introduced very early, immediately after the introduction of neutron resonances, rather than several chapters later, in reactor control. To keep size within bounds the authors have trimmed the earlier edition wherever possible; a solution to the reflected reactor and the neutron cycle for a thermal fission system are gone, along with such historical exercises as the variation of resonance escape probability (p) with thermal utilization (f) as the moderator-fuel ratio is changed in uniform mixtures of graphite and natural uranium. The exponential pile survives, for those who may still wish to do such measurements in laboratory courses.

Multigroup diffusion theory leads off the chapter on reactor analysis, and the need for and methods employed in large machine computations are carefully developed. Representative codes are mentioned by name. Fuel depletion calculations and an introduction to transport theory are also presented. With this material, students in our senior nuclear engineering course were able to utilize the "Nuclear Engineering Computer Module, RS-8, Multigroup Calculations" with a minimum of supervision.

Portions of reactor kinetics and control have been revised without changing the basic content and approach. The temperature coefficient of reactivity is developed to emphasize the net effect on a thermal or fast reactor, rather than effects on individual reactor parameters. Important operational terms, such as isothermal temperature coefficient and power coefficient, are explained; Doppler broadening is discussed for various fuel compositions.

Material on reactor control includes excellent sections on the function of control systems in the pressurized water reactor (PWR) and the boiling water reactor, and the shutdown margin, an important parameter frequently ignored in textbooks. Treatment of rod worth, a difficult experimental measurement, is rather sparse. The concepts of rod bank swapping, rod shadowing, and deboration measurements are generally omitted. In earlier editions, Glasstone and Sesonske often discussed experiments and experimental techniques. Unfortunately, for some of us, omission of these topics is most easily justified when trimming is necessary.

The chapter on energy removal reflects current concerns. Additions to the general development include gap conductance, transient heat transfer, core design constraints, and statistical core design. A new section on liquid-metal heat transfer supports the fast reactor concepts developed.

As before, the authors consider nonfuel materials in one chapter, followed by a second on reactor fuel. Nonfuel materials is now less general, and specific problems such as nondestructive testing surveillance and stress corrosion cracking address current operating plant concerns. The importance of good water chemistry and the steam generator tube failure problem in PWRs has been omitted. Treatment of the reactor fuel system includes modeling principles and available codes, waste storage options, and nonproliferation concepts, such as denatured fuels and the Civex process.

A comprehensive treatment of radiation problems inherent in nuclear plant operations is included in the chapter "Radiation Protection and Environmental Effects." Exposures as low as reasonably achievable and other environmental concerns such as radiation exposure pathways and radwaste treatment are included. Dispersion of effluents and siting implications are considered later in the chapter on reactor safety.

The authors present reactor safety in 55 pages. Even