Media Reviews

Plant Sciences. Edited by Richard Robinson. Macmillan Reference USA (an Imprint of the Gale Group): New York, 2001. Illustrations. 4 volumes. lvi + 957 pp. 22.0 ∞ 28.3 cm.; hardbound; ISBN 0-02-865434-X. $406.25.

All animals, including humans, depend ultimately on photosynthesis for their food. Readers of this four-volume, 300,000-word encyclopedia, a set in the Macmillan Science Library series for students and laypersons, will find out how plants accomplish this photochemical alchemy, will learn about the extraordinary variety of form and function within the plant kingdom, and will be able to trace their 450-million-year history, diversification, and evolution, from the very first primitive land plants to the more than 250,000 species living today.

With the help of agriculture humans were transformed from a nomadic, hunting and gathering species numbering in the low millions into the most dominant species on the planet with a population currently exceeding six billion. Agriculture has shaped human culture profoundly, and together the two have reshaped our planet. This encyclopedia explores the history of agriculture, its practice today, both conventionally and organically, and its impact on the land, atmosphere, and other creatures that share our planet with us. It also details the history of the scientific understanding of plants through experimentation and the development of rational classification schemes based on evolution. Biographies of more than two-dozen scientific pioneers and essays on the history of physiology, ecology, taxonomy, and evolution are included. A wide range of entries describes our still-changing understanding of evolutionary relationships, genetic control, and biodiversity.

Each of the 280 alphabetically arranged, authoritative, up-to-date, cross-referenced, and signed entries by 216 contributors from academic and research institutions, industry, and nonprofit organizations, mostly in the United States but also in Canada, the UK, Austria, Germany, and Denmark, has been newly commissioned for this encyclopedia. They range in length from about 500 to 6,000 words. Almost every entry is illustrated, and numerous photographs and diagrams (many full-page and in full color), tables, boxes, and sidebars enhance the reader's understanding. Most are followed by a list of readily available related articles and a short reading list for readers seeking additional information. Technical terms and jargon are avoided, but necessary unfamiliar terms are highlighted and defined in the margins.

Each volume includes a one–page geological time scale, a list of contributors and their affiliations (three triple-column pages), a table of contents for all the volumes (four double-column pages), a glossary of technical terms from "abiotic" to "zygote"(16 pp), a topic outline that groups entries thematically (9 double-column pages), and a detailed index. Although chemical entries predominate under the topics of "Biochemistry/Physiology," "Drugs and Poisons," "Foods," "Nutrition," and "Photosynthesis," chemical topics are found throughout all four volumes. The last volume also contains a cumulative index of concepts, names, and terms for the entire set (49 triple-column pages). Because many subjects are not treated in separate entries but within the context of comprehensive articles, this index will guide readers to discussions of these subjects.

I am pleased to recommend this comprehensive, eminently readable, and modestly priced reference work to students, chemists, chemical educators, and anyone interested in the broad area of plant sciences.

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How to Use Excel in Analytical Chemistry and in General Scientific Data Analysis. By Robert de Levie. Cambridge University Press, U.K. xiv + 483 pp. US$44.95. ISBN 0-521-64484-4.

Any book about the use of spreadsheets to enhance the data analysis in any field of study is likely to be prejudged as a collection of spreadsheet templates. The hope is that these templates can be copied and used by instructors and students for assignments. This book is not a collection of such templates. It is a smoothly written, excellent tutorial about how such spreadsheets are created, and thus how you can create your own quite complex spreadsheets. By complex spreadsheets I mean those that utilize Excel's Solver and Visual Basic abilities for applications (VBA) that do much more than simpler spreadsheets do.

As the title implies, the examples chosen are of interest to analytical chemists, but any chemist whose interest includes the manipulation of data according to some mathematical theory can profit from a study of de Levie's methods. Analytical chemists will find more than the usual Gaussian plots and titration curves. There are spectrophotometric spreadsheets, chromatography simulations, peak-area calculations, and even polarography and other voltammetry experiments. By the way, the titration curves use the "progress of titration" method. This follows the procedure of plotting the ratio of the volumes involved versus the pH, instead of trying to expressing pH as a function of titrant volume. This approach yields multiparameter equations that can be fit to the titration data by nonlinear-regression techniques. The equivalence point can then be deduced from the fit rather than from some point of inflection. This book would be worth its cost if it contained nothing but this section on titrations.

The chapter on kinetics is not a tutorial on how to plot and fit data to integrated rate equations. It is instead a tutorial on how to approach kinetics by numerical simulation of the differential equations involved. This approach, in the limit of small step size, of course yields the same integrated equations, but by starting from the differential equations, it allows an extension of the spreadsheet capabilities to heterogeneous catalysis and to oscillating reactions.

The final chapter on spreadsheet programming includes, among other useful VBA macros, a bidirectional Fourier-transform macro. This is advanced spreadsheeting in its most elegant form.

Finally, I offer my impression of de Levie's writing style. It is clear, as brief as is possible, and gives an underlying perspective on what these spreadsheets are doing that I consider refreshingly honest. For example, when discussing Solver's ability, or lack of it, to find the correct minima, I quote

> Note that these limitations make eminent sense once you understand what Solver does, and are no different from those encountered when we extract information from ordinary experiments, without a computer. It is just that we often come to expect too much of programs or of machines. Have you ever seen a horse win a race without a jockey? Solver is like that: a very competent program that could be a champ—but only when you tell it where to go, and how to get there.

Although the book does not include a CD-ROM containing the spreadsheets, the VBA macros are available both on a Web site and in the text. Sorry, no templates, but a very good book. No analytical chemistry teacher, no serious analytical chemistry student, should fail to acquire this book.

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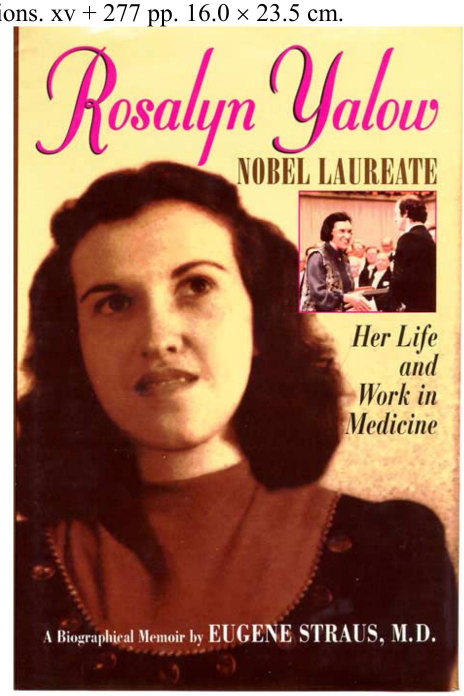
Rosalyn Yalow, Nobel Laureate: Her Life and Work in Medicine. By Eugene Straus, M.D. Plenum Trade: New York, 1998; hardbound, out of print; ISBN 0-306-45796-2; Perseus Press**:** Cambridge, MA, 2000; paperbound. $16.00. Illustrations. xv + 277 pp. 16.0 × 23.5 cm.



On December 10, 1977, in Stockholm's *Konserthus* (Concert Hall), Sweden's King Carl XVI Gustav awarded one half of the Nobel Prize in Physiology or Medicine to Rosalyn Yalow of the Veterans Administration Hospital, Bronx, New York "for the development of radioimmunoassays [RIA] of peptide hormones." He presented the other half to Roger Guillemin of the Salk Institute, La Jolla, CA and Andrew V. Schally of the Veterans Administration Hospital, New Orleans, LA, both of whom used RIA extensively, "for their discoveries concerning the peptide hormone production of the brain." Yalow was the second woman to receive this honor (Gerty Therese Cori and her husband Carl Ferdinand Cori had received half of the prize in 1947 "for their discovery of the course of the catalytic conversion of glycogen"), but she was the first American-educated woman to win the prize.

Eugene Straus, M.D., a gastroenterologist, Professor of Medicine and Chief of Digestive Diseases at the State University of New York Health Science Center in Brooklyn, and Yalow's longtime friend and colleague, begins his "biographical memoir" with her sudden stroke on January 1, 1995, when she was taken to a hospital, where, soiled with blood and unrecognized, she was "dumped" as a charity case onto another hospital. He then contrasts her slow and ultimate recovery from her crippling illness with her earlier, productive years that he chronicles in empathic but objective detail based on his own contact with her and extensive interviews with family and colleagues.

Rosalyn Sussman, sometimes characterized as "Madame Curie of the Bronx," was born on July 19, 1921 in New York City, as the only daughter and second child of uneducated, lower middle-class Jewish parents. Her father, Simon, of Russian descent, was born on Manhattan's Lower East Side, and her mother, Clara (née Zipper), had emigrated to the United States from Germany at the age of four. Although neither parent had any education above elementary school, like many other Jews or immigrants, they stressed higher education as a means of upward social mobility for their children.

A willful, headstrong child, Rosalyn became interested in science at Walton High, an all-girl school in the Bronx. In 1941 she graduated *magna cum laude* and Phi Beta Kappa from Hunter College for women (now part of the City University of New York), intending to become a physicist rather than an elementary school teacher as desired by her parents. She received a graduate assistantship in physics (the first woman since 1917), a field then reserved almost exclusively for men, at the University of Illinois, Urbana, where she was the only woman among 400 members of the College of Engineering faculty. In her words, "the draft of young men into the armed forces, even prior to American entry into the World War, had made possible my entrance into graduate school."

On her first day on campus, September 20, 1941, she met fellow physics graduate student Aaron Yalow, her future husband and an Orthodox Jew who was the son of the chief rabbi of Syracuse, NY. Outshining her male classmates, she earned 21 As in her courses and one A^- — in electrodynamics laboratory. The prejudice against women in science at the time was such that the Chairman of the Physics Department told her that she was a good student but "that A^- confirms that women do not do well in laboratory work." Working under the supervision of Maurice Goldhaber, in 1942 she was awarded an M.S. degree in physics and in 1945 a Ph.D. in nuclear physics.

On June 6, 1943, Rosalyn married Aaron Yalow. She believed "that all women scientists should marry, rear children, cook, and clean in order to achieve fulfillment, to be a complete woman." Yet she is definitely not a feminist. She maintains that "the war gave women like her opportunities, not a feminist movement, and if the opportunities dwindled after the war, she feels that it was because women didn't want them." With the help of a longtime maid, her mother, and an understanding and uxorious physicist husband who supported his ambitious and overwhelming partner, she was able to combine career, marriage, and motherhood. She refuses to accept awards restricted to women, which she regards as a sign of reverse discrimination.

Both her children—a son, Benjamin, and a daughter, Elanna, obtained their Ph.D.s and are active in the fields of science fiction and daycare, respectively. In the face of evidence to the contrary, Yalow insists that "her children paid no price for the demands of her scientific career." Her daughter presents an unflattering portrait of Yalow as a wife, mother, and grandmother: "She just wasn't physically around…..She didn't do the kinds of things that parents are supposed to do to make their kids believe that they value what their kids are doing….She was so demeaning to my father, just completely emasculating." Yet Elanna concludes, "I think she was a pretty wonderful mom."

After a stint as assistant professor of physics (1946–50) at Hunter College, in 1950 Yalow, who had been introduced to medical physics by her husband and who had been working as a part-time consultant at the Veterans Administration Hospital in the Bronx, became a physicist and assistant chief of the radioisotope service at the hospital. She was joined that same year by Solomon A. Berson, a medical internist who had just completed his residency at the VA Hospital.

In a fortunate, synergistic collaboration and without the aid of even a single research grant the two investigated various medical applications of radioisotopes until Berson died at age 54 of a massive heart attack on April 11, 1972. Although neither would have accomplished alone what they achieved together, Yalow admits that she was luckier than Berson, "because, as a woman and a nonphysician, she needed a male physician to lead the way and protect her."

By combining techniques from radioisotope tracing and immunology they developed radioimmunoassay (RIA)—the first technique to use radioisotopic techniques to study the primary reaction of antigens with antibodies. This extremely sensitive and simple method for measuring minute concentrations of biological and pharmacological substances in blood and other fluid samples initiated a revolution in theoretical immunology and even all biology itself. In 1959 they first used RIA to study insulin concentrations in the blood of diabetics (Yalow's husband had diabetes), but their technique soon found hundreds of other applications. Although the commercial ramifications of their new technique were tremendous, according to Yalow, "We never thought of patenting RIA. Of course, others suggested this to us, but patents are about keeping things away from people for the purpose of making money. We wanted others to be able to use RIA."

Their intensively creative relationship was so close that rumors of an affair between the two circulated, and a previous reviewer of this book even mistakenly referred to Berson as "her second husband." According to Straus, they "had an intellectual and scientific marriage, never a love affair." Yalow herself said, "Did Sol and I always get along? Do husbands and wives always get along? No. You have fights and it doesn't mean anything. It was almost like a marital relationship. The fellows were our children." At Berson's funeral the usually emotionally controlled Yalow "wept openly, continuously….her unprecedented display of deep feeling…attracted much attention." A colleague even declared that Berson had left "two widows."

Berson's death was Yalow's "low point, both professionally and personally." After his demise Yalow had to show that she was "more than just his technician." No surviving member of a scientific team had ever received a Nobel Prize. At a dedication ceremony on April 4, 1974, she named her research laboratory, where she had become chief of nuclear medicine in 1970, in honor or her collaborator of 22 years. In 1968 she became research professor at the Mount Sinai School of Medicine, where she was appointed distinguished service professor (1974–79), and where in 1986 she became the first Solomon A. Berson Distinguished Professor at large. Yalow was showered with numerous honors, including the prestigious Albert Lasker Basic Medical Research Award (the first woman to win it), which is often a precursor of the Nobel Prize in physiology or medicine, the National Medal of Science (the United States' highest science award), and more than 50 honorary degrees.

In 1991 Yalow retired from the VA Hospital at the mandatory age of 70. Her husband died on August 8, 1992. Because she feels that future generations should provide equal access to scientific careers for people of ability, she states, "I feel that it is now my duty to speak to young women, to encourage them to have careers, and particularly careers in science. I'm very happy to have the opportunity to speak to the girls."

Straus' volume is no hagiography. He admits that "Rosalyn has not been universally admired, and that's an understatement. She has been called arrogant, belligerent, and worse." His volume, copiously illustrated with 29 figures and each chapter of which is prefaced by a pertinent quotation by Yalow or others, includes lengthy and frank quotes from relatives and colleagues, with many of whom she had strained relationships. His fascinating, compelling, and well-written saga, which reads like a novel, presents a balanced portrait of a "Queen Bee" who "always seemed to command center stage." An "alpha female, someone who could lead the pack," she stubbornly refused to compromise her commitment to hard work and scientific integrity.

More than a biography, Straus' book also deals with gender bias, anti-Semitism, research and patient care in hospitals, the public's unwarranted fear of radioactivity, microwave ovens, basement radon, and other scientific and societal issues. He details the life and scientific career of an outspoken, aggressive, intensively competitive, critical, and complex woman who has become a role model for female scientists although perhaps not in personal relationships. His book should not only appeal to practicing scientists and historians of science but should also serve as a cautionary tale about the price to be paid by women who wish to pursue a career in science.

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Fundamentals of Electroanalytical Chemistry. By Paul M. S. Monk, John Wiley & Sons: Chichester, England. 384 pp. £34.95. ISBN 0471 88140 6.

The series of texts *Analytical Techniques in the Sciences* aims to provide a teaching resource for people unable to take advantage of more conventional methods of education in analytical methods. *Fundamentals of Electroanalytical Chemistry* discusses this wide-ranging subject around a series of discussion questions. After familiarization with the response to these discussion questions, the reader can assess their understanding of the material covered through self-assessment questions which are interspersed frequently throughout the book. These questions serve to reinforce the concepts under discussion, and succinct answers are provided at the end of the text. Given the aims of the series it is a complement to the book that working one's way through the text is similar to participating in a series of informal workshops on electroanalytical methods.

The book begins with two chapters that provide an overview of the concepts of electron transfer, current, and electrochemical potential. Chapter 3 discusses the principles of equilibrium electroanalysis in some detail, and it leads up to a description of proton- and fluoride-selective electrodes. The chapters on dynamic electrochemistry begin with an introduction to coulometry and diffusion-controlled mass transport. Methods that include chronoamperometry and cyclic and pulsed voltammetries are then discussed, and a comparison of these methods is presented. This section of the book is completed with a description of voltammetry under convection control and finally electrode kinetics.

The closing chapters of the book address topics such as electrode preparation, spectroelectrochemistry, data processing, and Web-based resources. Given that the book is intended for students unable to access conventional education it was a little disappointing that more extensive use was not made of cross-referencing. A number of concepts were introduced in a cursory yet advanced level at the beginning of the book, and this left a number of questions unanswered. These questions were answered on reading through later sections of the book but were not easily located in the index.

This book provides a useful companion to standard and advanced texts in the subject area and for which the author provides an extensive bibliography. The book is well-presented with clear and helpful illustrations. In addition to discussion of the usual aspects of electroanalysis, it includes mention of the problems often encountered in practical electroanalysis. The latter is not only informative but serves to reinforce many of the principles underlying such measurements. While it is aimed at students without access to conventional education, the book will undoubtedly also prove to be a valuable study aid for undergraduate students taking more conventional courses in electroanalytical methods.

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Swarm Intelligence. By James Kennedy and Russell C Eberhart with Yuhui Shi. Morgan Kaufmann Publishers: San Francisco, 2001. £43.95. xxvii +512 pp. ISBN 1-55860-595-9.

If the title suggests that this might be a book about the birds and the bees, you would not be so far from the truth. Bees might not appear in the index, but flocking birds certainly do, along with ants, herds, bacteria, and even feral humans.

So is this a biology text, or perhaps something in the social sciences? Actually, it is neither. *Swarm Intelligence* is part of the Morgan Kaufmann Series in Evolutionary Computation, and it is further evidence of the way in which the computer scientists and engineers are finding ever more intriguing ways to solve scientific problems.

The Morgan Kaufmann series is edited by David Fogel, a (computational) evolutionary scientist of considerable standing. One would anticipate that a book to which he put his name, even as editor, would be authoritative and readable. This book is everything one would expect.

Most scientists have at least heard of neural networks and genetic algorithms, even though they may never have done anything useful with such beasts. Neural networks have been around for several decades, loosely modeled on the way the brain is (or at least was) presumed to function. Genetic algorithms too have a biological ancestry. Developed from the work of John Holland, and making use of evolutionary ideas, they constitute a set of algorithms whose aim is to try to solve optimization problems.

Swarm intelligence is a technique of much more recent vintage, which again uses ideas drawn from nature to construct algorithms, that potentially can solve scientific (and other) problems.

The authors disarmingly tell us that “The central algorithms comprise just two lines of computer code.” Just two lines? A bit disconcerting. Why, one might then wonder, are 512 pages required to let the reader in on the secret? Just give us the code and let’s be done with it. However, we are given a hint of the deeper complexity when it is revealed that the book is “...about simple procedures leading to complex results.” Even that though does not quite explain why such a substantial book is needed to cover an apparently simple topic.

Things become clearer when the authors start to provide examples. Craig Reynolds published a fascinating, and influential, study of bird flocking in 1987. He showed that only simple rules were needed to make a set of “computational” birds flock realistically. Reynolds created a set of rules for his birds so that they:

(a) avoided crashing into one another by pulling away if they got too close,

(b) tried to move toward what they perceived to be the center of the flock, and

(c) attempted to fly at speeds similar to their neighbors.

Simple rules indeed, but with just these rules, the computerized birds behaved in a fashion very similar to the apparently sophisticated behavior of real flocks. We see already a hint of how simple rules can create apparently quite complex results.

Swarm intelligence is a computational recipe that puts these ideas into practice. It brings together ideas from several computational fields, in particular the genetic algorithm and cellular automata. The basic premise is that, while it is possible in principle to solve complex problems using a single complicated method, it should also be possible to tackle many types of problem using a large number (a “swarm”) of simple reasoning units, each of which can accomplish only elementary tasks. This is the same sort of argument that underlies neural networks, in which the trivial units in a network (neurons) can, when combined into a larger whole, solve quite difficult problems, even though each individual unit is capable of only simple computations.

Now, this may sound like a computer buff’s book, rather than one that might interest an average chemist, but this would not be a fair judgment. There are at least three powerful arguments in favor of this book, drawing an audience from well beyond computer science.

First, the book is specifically intended for a lay (albeit scientifically-minded) audience. One needs neither to be familiar with artificial intelligence, nor to have prior experience of genetic algorithms or cellular automata to appreciate and understand this book. The principles of both, and of other techniques as well, are explained lucidly and at a sensible pace. If one has met the methods before, these sections can be scanned over, or omitted entirely, but those who are newcomers to the field should find the authors' explanations clear and well-paced.

Secondly, this book is unusual in the extent to which the authors weave noncomputational, even philosophical, ideas into the text. These are not some minor musings, padding added as an afterthought, but an integral part of the discussion. The nature of evolution, the nature of intelligence, the question of what one means by intelligent computers are all discussed in a fashion that is engaging yet is tied in effectively with the principle aim of the authors—that of outlining the principles of swarm intelligence.

The authors discuss, for example, why it is that computers can already mimic the intricacies of human conversation with considerable success. This is, the authors argue, because computers can exploit ".....the shallowness or mindlessness of most conversation." Not very flattering, but it might just be true.

The third reason why this book may find an audience well beyond the confines of computer science is the possibility that the methods it outlines will put down roots in chemistry, physics, and other areas of science. There remain numerous problems in the physical sciences that conventional methods of attack fail to solve adequately. Some of the newer computational methods in the broad field of artificial intelligence have proven effective at tackling these problems, and Swarm Intelligence is another potentially useful tool in the armory.

Entertaining and thought-provoking—but I was disappointed by one aspect of the book. The bulk of it is taken up with a presentation of the background to Swarm Intelligence, and a description of its use on model problems. Few "real-world" applications are discussed, and this makes it harder for the interested newcomer to the field to judge whether this is a fascinating, entertaining but ultimately limited technique, or whether it has the potential to rival genetic algorithms and cellular automata as a method of real power in the solution of scientific problems. It is perhaps a little unfair to criticize the authors for this paucity of applications, because a text is not necessarily the most appropriate forum in which to present them, but it would help those new to the field to appreciate the potential of the method were more real examples to be given.

This is a small quibble though. The writing in *Swarm Intelligence* is lucid throughout and the limited range of applications little more than an irritation. This is a book worth reading just for the breadth of topics and ideas the authors want to discuss. You will need an interest in computers and computational methods to summon up the courage to start on the 512 pages, but persistence will be well rewarded.

Full of ideas, written about a technique that perhaps may crystallize into one of real promise, this is a book any computational chemist should be happy to settle down with.

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The Transuranium People: The Inside Story. By Darleane C. Hoffman, Albert Ghiorso, and Glenn T. Seaborg. Imperial College Press: London, England; distributed by World Scientific Publishing Co.: Singapore; River Edge, NJ; London, England, 2000. Illustrations. xciii + 467 pp., 15.5 × 22.2 cm., hardcover $75.00. ISBN 1-86094-087-0.

The Lawrence Berkeley Laboratory (formerly the Lawrence Radiation Laboratory), with which the authors of this fascinating book have long been affiliated during what has been described as a "golden age" of discovery, is the site of the discovery of more transuranium elements than any other laboratory in the world. The book's title is well chosen, and the authors — undisputed nuclear pioneers — are the ideal persons to have written it. The volume is a felicitous and balanced blend of personal reminiscences, revelations, opinions, anecdotes, nuclear science, and the history of science and technology. It should appeal not only to persons interested in these matters but also to anyone concerned with the development of science policy and the role of governmental support for research during both wartime and peacetime. Readers for whom the scientific portions are too technical will enjoy the recollections of the authors, who, conscious of their place in history, have recorded in incredible detail the events in which they shared.

The volume is carefully organized with each of its 15 chapters divided into numbered sections, subsections, and sub-subsections, and meticulously cross-referenced. Although scrupulously documented with 245 end-of-chapter references, it is eminently readable and frequently laced with humor. A sense of the authors' excitement evoked by the historical events in which they participated is conveyed by their frequent use of exclamation points. The book reads like a veritable "Who's Who" of nuclear science; hundreds of scientists, both well known and more obscure, come to life on its pages.

The text proper is preceded by a 93-page preface: a three-page tribute to 1951 Nobel chemistry laureate Glenn T. Seaborg (1912–1999), who died after suffering a stroke at the August 1998 American Chemical Society national meeting in Boston; first-person "Intimate Glimpses of the Authors' Early Lives" (72 pp.); and a three-page glossary of the numerous acronyms, decay modes, units, and prefixes referred to in the book. Each of the authors presents interesting, charming, and often little known details about his or her life, both personal and professional.

For example, we learn that Darleane Hoffman (née Christian), was born in 1926 and at Iowa State University, Ames decided to switch her major from applied art to chemistry after taking a required course in home economics chemistry at a time when an unusual profession for a woman such as chemistry was usually limited to "spinsters." She recollects that in 1951, when she married physics graduate student Marvin Hoffman, who remained at Ames to pursue his doctoral studies, while she, who had just received her Ph.D., left to work at the Oak Ridge Nuclear Propulsion Department, Marvin's *Doktorvater* told him the marriage was a "horrible mistake…[that] would never last under such unconventional circumstances." Their daughter, Maureane, is now a professor at the Duke University Medical School, and their son, Daryl, is a plastic surgeon.

When Hoffman went to the Radiochemistry Group of the Test Division of Los Alamos Scientific Laboratory (LASL) in 1952, she was told, "We don't hire women in that Division." Despite these and other examples of sexism, she went on to become a "genuine transuranium person," becoming the first woman Division Leader of the LASL Chemistry-Nuclear Chemistry Division, and eventually Professor of Nuclear Chemistry at the University of California, Berkeley (since 1984). She became a recipient of numerous honors; her American Chemical Society national awards include the Award for Nuclear Chemistry (first woman, 1983), the Garvan Medal (1990), and the Priestley Medal (the society's highest award, 2000).

The fifth of seven children of a poor family, whose father sold "bootleg" liquor during Prohibition, Albert Ghiorso, who was born in 1915, received his bachelor's degree as an electrical engineer from the University of California, Berkeley in 1937 during the Great Depression. Because no jobs were available, he earned money by constructing and selling amateur radio equipment. By 1941 he was producing Geiger-Müller counters for the Manhattan District Atomic Energy Project and often visited the UC, Berkeley Radiation Laboratory, where he met Wilma Belt, the secretary of Donald Cooksey, Ernest Lawrence's deputy. In 1942 he married Wilma and joined the Chicago Metallurgical Laboratory, where he took care of Seaborg's group's instrumentation needs "to determine the complete chemistry of an element that no one had yet seen" (plutonium). He developed new and improved methods of determining different types of nuclear radiation and was involved in the discovery of several transuranium elements. In 1946 he returned with Seaborg to the Berkeley Radiation Laboratory, where he continues to work. In 1973 he received the ACS Award for Nuclear Chemistry. His son, William Belt Ghiorso, who joined the laboratory in 1978, joined him in an experiment to produce element 110.

Because Seaborg, for more than six decades, kept a daily journal since January 1, 1927, when he was fourteen, we were not surprised by the depth of detail in his reminiscences. Although we have written several articles about him, we encountered biographical facts of which we were unaware and photographs that we had not seen (The picture of his third-grade class shows that as early as the age of nine, because of his height, he was already relegated to the back row of group pictures). Fortunately, he was able to proofread the final text before his stroke.

Chapter 1, "Introduction" (27 pp.), orients the reader with a pithy summary of the main events in the discovery of the transuranium elements, beginning with Fermi, Amaldi, D'Agostino, Rasetti, and Segrè's bombardment of uranium with neutrons (1934), through Hahn and Strassmann's now classic paper in *Nature* (1939), to the superheavy elements (SHEs). Along with quotations from pertinent articles in both the original languages and English translation, a lengthy (10 pp.) excerpt from an address by Seaborg in 1970 gives an account of early days at the Berkeley Radiation Laboratory.

Chapter 2, "Neptunium and Plutonium" (15 pp.), discusses the discovery of the first two transuranium elements by use of the 60-inch cyclotron, while Chapter 3, "The Plutonium People" (57 pp., the longest chapter), describes the wartime characterization of the properties of plutonium and the development of the process for its production, resulting in the first sample of the element to be seen without a microscope. More than 200 of the persons involved are mentioned or profiled. Chapter 4, "Americium and Curium" (30 pp.), details the use of energy absorbing foils over the targets to fractionate the isotopes of the first two transplutonium elements — a new tool that became a routine procedure for future research as the half-lives of the elements to be discovered became shorter.

Chapter 5, "Berkelium and Californium" (25 pp.), discusses the first elements to be discovered after the transfer of Seaborg's group from the Chicago Metallurgical Laboratory to Berkeley with emphasis on the use of cation exchange techniques for their isolation. Chapter 6, "The 'Big Bang': Discovery of Einsteinium and Fermium" (46 pp.), recounts the dramatic, unplanned, and unexpected synthesis of two elements as by-products of the debris of the hydrogen bomb dubbed "Mike," the first U.S. thermonuclear device, detonated at Elugelab Island in the Eniwetok Atoll of the Marshall Islands (November 1, 1952). The elements heavier than fermium (at. no. 100) could not be produced at reactors via neutron capture but required light or heavy ion bombardments at suitable accelerators.

Chapter 7, "Mendelevium" (29 pp.), describes the *tour de force* of all research on the transuranium elements — the discovery of a new element "one atom at a time" for a grand total of 17 atoms by a new technique. The success of the recoil experiment led to its use for all the following discoveries. Mendelevium was the last transuranium element to be discovered and identified by direct radiochemical separation of the element itself.

The elements beyond mendelevium were first identified by detection of their nuclear decay, and they required new techniques for their positive identification. This is one of the reasons for the controversies and friendly competition between workers at Berkeley and Dubna and elsewhere concerning the discoveries of elements 102 and heavier. These decades of controversies over priority in discovery and naming are detailed in the chapters on these elements — Chapter 8, "Nobelium and Lawrencium" (28 pp.); Chapter 9, "Rutherfordium and Hahnium" (42 pp.); Chapter 10, "Seaborgium" (28 pp.); Chapter 11, "Bohrium (107), Hassium (108), and Meitnerium (109)" (13 pp.); and Chapter 12, "Elements 110, 111, and 112" (28 pp.) as well as in Chapter 13, "Naming Controversies and the Transfermium Working Group" (31 pp.). Chapter 10 includes Ghiorso's account of the more than two decade-long "untold story" of seaborgium, the naming of which Seaborg regarded as an even greater honor than his Nobel Prize. Chapter 14, "Searches for the

Superheavy Elements" (34 pp.), reviews reported discoveries of SHEs — "hits" and "near misses," how scientists were sometimes led astray, and current plans to produce them. Chapter 15, "Reflections and Predictions" (7 pp., the shortest chapter), contemplates the past and forecasts the future with an imaginative, futuristic periodic table projected to element 168.

The book is copiously illustrated with 125 numbered figures of individual persons (formal and informal snapshots, both familiar and previously unpublished), group photographs with almost all persons identified, equipment, apparatus, buildings, diagrams, graphs, schematics, elution data, documents, letters, organizational charts, decay sequences, discovery time lines, aerial views of nuclear explosions, and periodic tables before and after Seaborg's actinide concept. Replete with numerous equations and reaction schemes, it considers not only theoretical aspects but practical applications as well. A detailed (27 pp.) name index is provided; the lack of a subject index is not serious because of the previously mentioned clear organization of the material. This unique volume is a rich gold mine of primary material that will be enjoyed by general readers while simultaneously providing specialized scholars with a valuable source for future research.

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