

BOOKS

Brookhaven: A Jewel in the Crown

Making Physics: A Biography of Brookhaven National Laboratory, 1946–1972

▶ Robert P. Crease
U. Chicago P., Chicago, 1999.
434 pp. \$38.00 hc
ISBN 0-226-12017-1

Reviewed by Robert W. Seidel

Robert Crease has written a useful and insightful history of Brookhaven National Laboratory, one of the crown jewels in America's scientific enterprise. Although he modestly eschews the role of the historian, preferring "biography" in the book's subtitle, Crease provides what is likely to be the definitive history of Brookhaven's first quarter-century. He brings the institution to life through vignettes of the lab's leading scientists, its extraordinary equipment, and its accomplishments in high-energy physics, solid-state physics, reactor development, and biology and medicine.

Crease is well placed to tell this story, since he has served as historian half-time at Brookhaven while teaching philosophy at the State University of New York, Stony Brook. In assembling his tale, he has made good use of the archives and of interviews with laboratory luminaries. Some of the lab's founders are now dead, but it is a tribute to Crease's skill that he is able to capture their voices.

The focus of the study is neither institutional nor scientific history, although Crease is sufficiently conversant with both to provide intelligible accounts of significant issues. His descriptions of Brookhaven's reactors, accelerators, computers, and detectors are succinct but sufficient to signal the importance of the machines and their products. His accounts of such important Brookhaven discoveries as strong focusing and the second neutrino are clear and will be

comprehensible to the lay reader.

A multipurpose national laboratory challenges description, because it pursues many activities that are simultaneously distinct and related to the nature of the institution. Crease's account is effective in putting these activities into a larger institutional perspective, while still acknowledging the individual style and contributions of those who led the lab's scientific programs. He does not hesitate to point out shortcomings in performance or differences in style, although his treatment of such lapses is sympathetic.

If he is less attentive to some of Brookhaven's rivals, in particular Lawrence Berkeley National Laboratory, it must be acknowledged that his biases reflect those of his subjects, scientists who sought to define themselves and their institution in contrast to more established centers of nuclear physics. When it comes to the institutional fortunes of Brookhaven, however, he is able to transcend the rather short-sighted perspectives of physicists and others who dismiss public relations and popular fear of their activities as unnecessary to the pursuit of science.

The Atomic Energy Commission and the contractors it imposed upon the laboratory receive the lion's share of blame for cost and schedule overruns on the reactors and accelerators built at Brookhaven in the decade following World War II. By insisting that these machines be built by contractors rather than the laboratory, Crease writes, the commission fostered an "awkward triumvirate management arrangement between the AEC, the lab, and the contractor. Lab scientists supposed that [the contractor] had matters in hand, [the contractor] thought the scientists were getting what they wanted, and the AEC assumed that any necessary interaction was taking place." Obviously, what we have here is a failure to communicate.

The lack of communication between Associated Universities Incorporated, which manages Brookhaven, and the laboratory, its patrons in the Atomic Energy Commission, Energy Research and Development Administration and the Department of Energy, and other constituencies, includ-

ing local taxpayers, reflected more than the isolation of the laboratory. There was, especially in the latter part of the period covered by Crease, a disdain on the part of Brookhaven's administrators for the political activity required to insure the continuance of good will. The ultimate denouement—the Department of Energy's 1997 cancellation of AUI's contract to run the laboratory—in the face of outrage over environmental pollution and declining support for the kind of big science Brookhaven had come to represent—repaid the hubris of its leaders with the halts of regulation and reform. Crease alludes to the roots of this tragedy in his account of the laboratory's early years. It is to be hoped that an equally detailed analysis of Brookhaven's history since 1972 is forthcoming.

Active Galactic Nuclei: From the Central Black Hole to the Galactic Environment

▶ Julian H. Krolik
Princeton U. P., Princeton, N.J.,
1999. 598 pp. \$99.50 hc
(\$39.50 pb) ISBN 0-691-01152-
4 hc (0-691-01151-6 pb)

Julian Krolik has written a textbook about AGN (active galactic nuclei) that really does take the reader from the tumultuous environment that likely surrounds an "active" black hole to that hole's galactic environment. The book focuses on processes believed to occur in the vicinity of a black hole that is accreting matter, and the observational consequences of these processes. The book, which is quite thorough, also covers observed properties of AGN over a broad range of wavelength and redshift.

The level of the material makes the book accessible to graduate or advanced undergraduate students of physics and astronomy. The text includes analytic arguments and derivations as well as detailed verbal descriptions of the processes themselves and related solar and galactic processes. The references and comparisons to currently debated topics

ROBERT W. SEIDEL is professor in the department of chemical engineering and materials science at the University of Minnesota in Minneapolis. He has written two books and numerous articles on the history of the national laboratories of the Department of Energy.

in other areas are quite valuable, helping to set the research problems related to AGN in a broader context. For example, in chapter 8, section 6.1, the heating of the solar corona is compared to the heating of plasma in the vicinity of an accretion disk. Detail about the precise way in which heating occurs is lacking in both cases, serving as an important reminder that it is not surprising if all is not clear about processes occurring in the vicinity of a massive, spinning, accreting, and possibly magnetized black hole.

The book will be particularly useful in educating young researchers, because of the style of presentation Krolik has adopted: a style illustrative of the general approaches and techniques used by astrophysicists. Observations are presented; a model is then constructed to explain the observations and is tested with additional observations. The limitations of the model and observations are often discussed. Also discussed is the fact that there may be a broad range of processes and observational consequences. The timescales over which different processes operate are often compared, which is always an important point when dealing with astrophysical processes. The book gives a sense of how complex and interrelated many processes can be.

Overall, Krolik's book provides a broad and thorough review of the standard model for AGN, including observational information and theoretical modeling. It will provide graduate and advanced undergraduate students with an excellent introduction to the field.

RUTH A. DALY

*Penn State University
Reading, Pennsylvania*

Properties of Materials

▶ Mary Anne White
Oxford U. P., New York, 1999.
334 pp. \$45.00 pb
ISBN 0-19-511331-4

Materials science fuels the latest technology, from the "Intel inside" to the flat panel display outside. Recent Nobel prizes in physics—for high- T_c superconductivity, for the integer and fractional quantum Hall effects—stand on the shoulders of materials advances. Yet, the physics curriculum, for majors and nonmajors alike, usually pays little heed to the principles and practices of materials science.

In the last several years, a spate of materials science books has appeared, offering alternatives or supplements

to such mainline engineering texts as William D. Callister Jr's *Materials Science and Engineering, An Introduction* (Wiley, 4th ed., 1997). The newer texts include Stephen Sass's *The Substance of Civilization* (Arcade, 1998), Ivan Amato's *Stuff* (Harper Collins, 1997), B. S. Chandrasekhar's *Why Things Are the Way They Are* (Cambridge U. P., 1998), and, now, Mary Anne White's *Properties of Materials*. White's book lies the closest to a traditional text; it assumes a technical orientation on the part of the student and includes mathematics at the level of early calculus. It does not match the intimacy and eloquence of Sass's work or the eclectic portraiture of Amato's, but it does provide a solid introduction to materials science.

White, a professor of chemistry, physics, and materials science at Canada's Dalhousie University, has employed an unorthodox organizing principle for her material. She orders sections in the book by the physical properties of matter: optical, thermal, electrical, magnetic, mechanical. This scheme permits the student to jump right into a healthy mix of science and phenomenology, with a sprinkling of intriguing technological applications. The text is enlivened by vignettes on familiar technologies—lasers, xerography, space-shuttle tiles, carbon-monoxide detectors—and by tutorials that guide students to explore the underpinnings of materials design and application. White's prose is clear and straightforward and is aided by well-chosen line drawings. Photographs are few but fine, including a memorable series of a shape-memory alloy sculpture at different temperatures. Notable as well are the useful compilations of "further reading" at the end of each chapter, including pertinent magazine articles from such popular publications as *Scientific American* and *New Scientist*.

White's unusual format has some disadvantages. For one, it leads to artificial designations, such as the characterization of phase equilibria as a "thermal property." More serious is the short shrift given to the central paradigm of materials science: the interrelationship between processing, structure, and properties. Industries rise and fall on the ability of materials scientists and engineers to translate insights about microstructural variations, which arise from different processing techniques, into tailored materials having specific properties and performance. Steel wires

with elongated grains make fine clothes hangers, but equiaxed grains lead to crumpled pants!

As a physicist, I miss the first-principles approach to the subject, more in tune with a book like Chandrasekhar's, which uses the rules of quantum mechanics to show how to build atoms from electrons, organize them into the periodic table and form solids from the elements. My engineering colleagues probably would decry the lack in White of a detailed discussion of the different types of steel or of the myriad strategies for creating composites—topics found in the 800 pages of Callister. Yet, I think White has struck an effective compromise in *Properties of Materials*, combining, in an approachable text of 300 pages, accurate science, a flavor of engineering, and the excitement of a burgeoning field.

THOMAS F. ROSENBAUM

*University of Chicago
Chicago, Illinois*

Accelerator Physics

▶ S. Y. Lee
World Scientific, River Edge, N.J., 1999. 491 pp. \$64.00 hc
(\$32.00 pb) ISBN 981-02-3709-
X hc (981-02-3710-3 pb)

Shyh Yuan Lee's *Accelerator Physics* textbook is based on an accelerator physics graduate course that Lee teaches at Indiana University and two courses he taught at the US Particle Accelerator School. It is intended as an introductory text for students planning to do thesis research in accelerator physics; as such it covers a wide range of topics that Lee divides into four chapters.

A short introductory chapter provides a good history of the field, along with typical layouts of accelerators and some of their applications. In the second chapter, the author provides a thorough treatment of the transverse motion of particles in an accelerator, using a Hamiltonian approach. While this appears at first sight to be more formal than necessary, it does create a good basis for the later discussion of the stability of particle motion in accelerators. Basic collective effects and nonlinear resonances are discussed at the end of the second chapter. The third chapter applies the same Hamiltonian approach to synchrotron motion. The interaction of the radio-frequency accelerating systems with the particle beam, and the major longitudinal collective instabilities, are treated in detail. The last section of this chapter provides a