and published their work, along with her own, in a regular column in *Scientific American*. Many of Mitchell's students went on to become professors at women's colleges.

By the time Mitchell retired, however, opportunities for women in science were becoming more restricted than those for men. In *Maria Mitchell and the Sexing of Science*, Bergland, a professor of English and of gender and cultural studies at Simmons College in Boston, points out that the expanding opportunities for antebellum women that brought Mitchell acclaim and employment were followed in the 1870s by a backlash that was particularly acute in the sciences. Drawing on the work of, among others, Kim Tolley, author of *The Science Education of American Girls: A Historical Perspective* (RoutledgeFalmer, 2003), Bergland argues that girls of Mitchell's generation were often more likely than boys to study science, whereas by the 1880s science was well on its way to being perceived as a masculine endeavor.

Such a thesis should provide an interesting framework for a study of Mitchell's life, yet Bergland's book is problematic. Her prose is repetitive; more troubling, many references are inaccurate and hard to follow, and explanations of the astronomy are too often misleading. For instance, Bergland asserts on page 176 that, "Under Maria Mitchell's leadership, Vassar would enroll more students in higher mathematics and astronomy than Harvard did from 1865 to 1888." As supporting evidence, the author refers to an 1865 letter by Mitchell in which she enthuses over her first class of students, speculating that it's unlikely there are "17 students in Harvard College who take Mathematical Astronomy." Although Bergland's claim may be true, the 1865 letter provides no data about the numbers of Harvard astronomy or mathematics students in 1865, or in any other year.

In another example that may frustrate readers, on page 63 Bergland quotes from a 1997 article in which, on the occasion of the sesquicentenary of discovery, the authors calculate the modern position and magnitude (that is, brightness) of Mitchell's comet. They muse that, although now an approximately 32nd-magnitude object, which is incredibly faint, the comet might in the future become detectable to telescopic observation should technology improve as "dramatically" over the next century as it has over the past century. Their statement hardly constitutes, as Bergland describes in her book, a report "to the American Astronomical Society that telescopes could still find the comet."

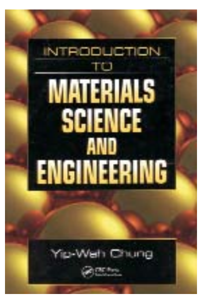
In her book, Booker recalls Mitchell's statement at the 1875 Women's Congress in Syracuse, New York, that "science needs women" (page 384). Her words are ambivalent, for they are at once a call for more opportunities for women in the sciences and an excuse for the gendered division of labor. Mitchell, who by all accounts hated to sew, could, when convenient, argue that women's skill with a needle showed that they should be readily employable for scientific tasks requiring patience, a careful eye, and a steady hand. Although she might have hoped that this argument would promote the hiring of women, she may not have anticipated that those women would be consigned to hunch over photographic plates to measure star positions or magnitudes or spectral types, while men designed the observing program and worked at the telescopes.

But Mitchell's words are also relevant: The individual choices she made—how to balance fame and family obligations, teaching and research, social constraints and personal ambitions—have faded with the passage of time, just as her handwritten verses or her photographs of the Sun have. Yet those issues, more broadly considered, are as crisp and sharply focused as ever. Mitchell is definitely worthy of our attention, and Booker's biography is a fine place to make her acquaintance.

Introduction to Materials Science and Engineering

Yip-Wah Chung
CRC Press/Taylor & Francis, Boca Raton, FL, 2007. $99.95 (287 pp.). ISBN 978-0-8493-9263-4

In the preface to his *Introduction to Materials Science and Engineering*, Yip-Wah Chung tells us that he aims to "inform, educate, and entertain." Of all the disciplines in engineering, materials science and engineering, a relatively unknown field outside of academic circles, faces the unique challenge of attracting new recruits. With that backdrop, Chung strives to convey to the uninitiated the wonders and practical importance of the field. True to his word, the author, a professor of materials science and engineering at Northwestern University, begins each chapter "with some simple facts, a story, or an experiment" to draw readers into the subsequent, more technical discussion. He is to be commended for pursuing such an experiment; however, I found that although the text succeeds in informing, it is less successful at educating, and for me it was even less successful at entertaining.



Instructors of materials science and engineering have a broad range of textbooks already available to them. Chung differentiates his text from others through his storytelling style, which may indeed be effective in generating enthusiasm for the field among some students. In terms of content, however, the book suffers from the usual flaw of modern materials science and engineering textbooks in that ceramics, covered in chapter 6, and polymers, discussed in chapter 7, are treated as afterthoughts; the unstated assumption is that "materials" really means "metals." But Chung's assumption is at least more relaxed than many: In chapter 3, the early treatment of electrical properties places semiconductors at almost equal standing with metals, and more examples of esoteric materials are sprinkled throughout the text.

As with most undergraduate textbooks on the subject, Chung's text begins chapter 1 with chemical bonding, crystalline structures, and x-ray diffraction; the author then moves on to defects in chapter 2. Any instructor of introductory courses in the field struggles with the question of whether to connect the discussion of defects to the physical properties they affect (such as point defects in connection with diffusion, and dislocations in connection with mechanical deformation) or continue with the fundamental descriptors of the material state. In chapter 2, Chung chooses to connect point defects to diffusion but defers the discussion of mechanical deformation to chapter 4. In my own teaching, I have found that students have no basis for understanding dislocations in the absence of the impact of those defects on mechanical properties, and it is unfortunate that the topics are disconnected in Chung's book. To justify the deferred presentation of the topic, the author contends in the preface that mechanical properties are outside of students' "comfort zone." But surely that argument depends on the background of the students.

Phase diagrams are treated in chapter 5, and after discussion of those pesky ceramics and polymers, in chapters 6 and 7, the text covers corrosion and oxidation of metals in chapter 8 and magnetic properties in chapter 9. Given the text's brevity, certainly not all aspects of materials can be presented, but it is not clear how Chung's chosen topics take precedence over, for example, optical properties, thermal properties, or processing strategies. That said, most undergraduate textbooks in this field include far more information than an instructor can possibly cover in a single semester; as such, they largely serve to accelerate deforestation and induce back injuries. The final chapter of Chung's text, chapter 10, is devoted entirely to thin films, another experiment that sets the book apart from others.

In each chapter the selection of specific topics is also distinctive. For example, chapter 1 has a discussion of x-ray diffraction characterization of thin films, chapter 2 covers diffusion mechanisms in biological systems, and chapter 7 treats polymeric fire retardants. Frequent references to modern technologies such as hydrogen fuel cells, thermoelectrics, smart materials, and nanomaterials give the impression that the book is up-to-date, but it also leaves it at risk of becoming quickly outdated as technology evolves while principles remain. The treatment of those various modern topics is generally cursory and, perhaps by design, leaves readers wishing for more. Thus, I find the book more informative than educational. Without depth to explain much of the "why," the text reads like a modern facts-and-figures book.

Moreover, because no author can possibly be an expert in each of the wide range of topics, errors, misunderstandings, and oversimplifications are inevitable. For example, the claim on page 81 that thermoelectric materials can easily achieve a desired combination of properties for attractive efficiencies (ZT values of 2–5) is a matter of tremendous debate. In another example, fuel cells are reduced to hydrogen fuel cells in what is apparently an attempt to capitalize on the hydrogen hype; in fact, fuel cells do not require hydrogen as a fuel. Such subtle points can hardly be addressed in a short text. More egregious than those debatable positions are several fundamental errors. For example, Schottky defects are presented incorrectly on pages 37 and 148, and the discussion in section 2.9 on defect concentrations confuses kinetics with thermodynamics. Other concepts, such as "free energy," are simply used without introduction; furthermore, the quantity presented without clarification in the appendix to chapter 2 is the Helmholtz free energy, although it is the Gibbs free energy that should be evaluated.

Two additional aspects of Chung's textbook warrant some comment. The first is the extensive use of footnotes, a mechanism Chung freely admits he employs to convey "fun" information. I found them distracting, as I expected that something relatively important, though tangential, would be inserted. The content was often disappointing. The most extreme example was a footnote on weight-loss strategies—the relevance is completely lost to me. The second aspect is the dismal quality of the figures. For a textbook that aims to entertain, I was struck that many of the line figures were so poorly constructed, not to mention the extremely low resolution of many of the photographs.

Chung's *Introduction to Materials Science and Engineering* experiments in its presentation of the subject. I can understand the author's rationale for including some of the most recent advances in the field, and I appreciate the great effort he has taken to capture the imagination of younger readers. For some students, the style will seem condescending, as it seems to imply a limited attention span; for others, it will inspire as intended. I recommend that instructors carefully evaluate the contents and approach of the textbook for themselves and for their students. An alternative text, Rodney Cotterill's *The Cambridge Guide to the Material World* (Cambridge University Press, 1985), succeeds in capturing the imagination while providing depth, albeit at the expense of breadth.

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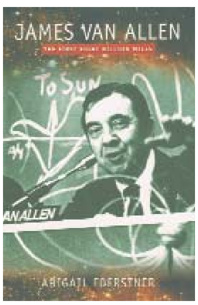
James Van Allen

The First Eight Billion Miles

Abigail Foerstner
U. Iowa Press, Iowa City, 2007. $37.50 (322 pp.). ISBN 978-0-87745-999-6

James Van Allen (1914–2006) has been one of the most widely recognized names worldwide for the past 50 years. Fame came soon after he and his team of scientists at the University of Iowa recognized that their "malfunctioning" Geiger counter aboard the *Explorer 1* satellite, launched on 31 January 1958, was actually performing properly but had been saturated by the intense flux of energetic particles trapped in Earth's magnetic field. Their understanding of what was happening did not come easily: It actually required data from a tape recorder aboard *Explorer 3*, which was launched on 26 March 1958. Van Allen announced the discovery of the "belts" of radiation at a meeting of the National Academy of Sciences and the American Physical Society on 1 May 1958 in Washington, DC. To the world those trapped energetic particles became known as the Van Allen radiation belts. Van Allen himself didn't use that term, but he was fond of noting around his house that the Van Allen belt held up his trousers.



Although the discovery of the energetic charged particles trapped in the geomagnetic field made him famous, Van Allen had been a leader in international cosmic-ray research for more than a decade and had been an important member of the team that developed the radio proximity fuse during World War II. Except for those of us steeped in the history of the Johns Hopkins University Applied Physics Laboratory, few people know much about Van Allen's work during the war. But Abigail Foerstner's *James Van Allen: The First Eight Billion Miles* provides a fine description of both his work and the global context for it. The subtitle refers to the fact that Van Allen's instrument on the *Pioneer 10* spacecraft had operated continuously just after launch in 1972 until the last signals from the spacecraft were received in 2003. During those 32 years *Pioneer 10* had traveled almost 8 billion miles. Although Van Allen's career has been well documented in a number of awards ceremonies and conferences, this book appears to be the first authorized biography.

Foerstner, a lecturer at the Medill School of Journalism at Northwestern University, has written an extraordinary book about one of the most influential scientists active during the last half of the 20th century. For more than six years, Foerstner had almost unlimited access to Van Allen's papers and journals; she also interviewed members of his family and dozens of his colleagues and former students. Most importantly, she had frequent and regular access to Van Allen himself. From her voluminous research, she has produced a fascinating story, beginning with his grandfather's move to Iowa in the 1860s. Van Allen's father, Alfred, was born in Mount Pleasant, Iowa, in 1869. He became a lawyer, joined his father's law firm, and was active in local government and politics. He began courting school teacher Alma Olney in 1907; she was 23 years old. They married in 1911, and Van Allen was the second of four brothers born during the first 10 years of their marriage. All four were raised to appreciate hard work, and to enjoy learning.

With the advent of satellites and space probes, space science became big science, with all the competition and politics that involves. Beneath his soft-spoken manner, Van Allen was a fierce competitor and a skilled negotiator in determining the course of the nation's space program. Those personal traits appear to have been inherited from his scholarly and disciplined ancestors.

Van Allen's experience in designing small and rugged electronic assemblies for the proximity fuse put him in good stead when he returned to his cosmic-ray research using German V2 rockets after World War II. He was a strong believer in keeping his instruments simple, reliable, and inexpensive; hence, he worked diligently to launch his detectors on ever smaller and cheaper rockets. He was instrumental in developing the Aerobee sounding rocket and the even cheaper rockoon, which used a balloon to launch a small rocket from high altitudes. As for the detectors themselves, it may be fair to say that he was unique in his ability to wring information from Geiger counters, detectors that were on the verge of obsolescence at the time of *Explorer 1*.

Throughout his career Van Allen was a champion of unmanned spacecraft and a critic of the manned space program. He did not denigrate the technology or excitement of manned spaceflight, just its effect on the budget for the unmanned program. Many of us planetary scientists agreed with him and are pleased that Foerstner has faithfully presented his views in her superb biography.

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Engines of Discovery

A Century of Particle Accelerators

Andrew Sessler and Edmund Wilson
World Scientific, Hackensack, NJ, 2007. $65.00, $37.00 paper (194 pp.). ISBN 978-981-270-070-4, ISBN 978-981-270-071-1 paper

"His love for physics was legendary and infectious." That is how Andrew Sessler and Edmund Wilson describe Donald W. Kerst, one of many characters who appear in their *Engines of Discovery: A Century of Particle Accelerators*, a romance on the particle-accelerator saga. The sentence can be applied to the major and minor characters in the book, and to the authors themselves. Such description is what comes out of this beautifully illustrated and written history of particle accelerators. It is a book about physics that has no equations, one in which the story of the motivations for technological progress are entangled with the lives of the people who have witnessed the building, brick by brick, of particle accelerators—from the first electrostatic accelerator to the ambitious Large