Howard Aiken: Portrait of a Computer Pioneer FREE

I. Bernard Cohen; Alfred E. Brenner

Physics Today **53** (3), 74–75 (2000);
https://doi.org/10.1063/1.883007

connections between cosmology and particle physics. The fact that cosmology is deeply linked with a variety of fields (such as astrophysics, nuclear physics, particle physics, and general relativity) makes it both exciting to study and challenging to teach. The depth and breadth of these links mean that, even when one is teaching very advanced students, compromises must be made between teaching a few things in-depth and surveying a wider range of topics.

Bergström and Goobar have chosen to cover a great range of topics quite briefly, and they make no pretense at providing an in-depth treatment of any topic. The book covers a range similar to that of the classic graduate-level text *The Early Universe* by Edward W. Kolb and Michael S. Turner (Addison Wesley, 1990), with the addition of special relativity, general relativity, quantum field theory, gravitational lensing, the standard model of particle physics, cosmic rays, gamma rays (including gamma-ray bursts), and black holes. All this in about 200 pages fewer than Kolb and Turner used to reach a more advanced audience.

The emphasis of *Cosmology and Particle Astrophysics* is on theory. Many of the end-of-chapter problems involve the derivation of various equations rather than more nitty-gritty astrophysical issues. For example, there is no mention of the cosmic-distance ladder, (although the use of supernovae as standard candles is discussed), but there is a brief discussion of the concept of Majorana mass in quantum field theory. (The solutions to the problems are supposed to be available on the World Wide Web www.physto.se/~lbe/cosm_book, but as of early February 2000, only chapter 1 had appeared.)

In trying to span such a wide range of topics, the authors, I feel, stretch the discussion pretty thin in most places. I am left concerned whether there is enough material to afford the student a foothold. The authors suggest that the book may be useful to astronomy students who are not inclined to take separate courses on field theory, but I am not convinced that such students will find much clarity in the book's rushed discussion of field theory and particle physics. One major disappointment was the quality of the index and cross-references. For example, "microwave background" and "CMBR" in the index cite only minor areas of the text and completely ignore a whole chapter (10 pages) on the subject.

Cosmology and Particle Astrophysics probably works best as a reference work, almost an expanded dictionary, where many things get mentioned but none are discussed at length. I could see it being particularly useful to a student who has had a more focused exposure to cosmology and particle physics and would like to pick up a few things about other topics and develop cross-links in these fields. However, such a student would certainly have to be theoretically inclined to feel comfortable with this book and also be willing not to depend too much on the index.

My advice to colleagues considering teaching from this book is to proceed with caution; look it over carefully. Is it at the right level for your students? Do you see sections that present things in a way you like to teach them? If you use it, you will probably need to supplement it in some way, perhaps by expanding on a selection of topics. Having considered all these issues, you may still find a place for *Cosmology and Particle Astrophysics* in your course. It is certainly a unique and interesting addition to the available texts in this area.

Andreas J. Albrecht
University of California, Davis

Howard Aiken: Portrait of a Computer Pioneer

I. Bernard Cohen
MIT Press, Cambridge, Mass., 1999. 329 pp. $34.95 hc ISBN 0-262-03262-7

Makin' Numbers: Howard Aiken and the Computer

Edited by I. Bernard Cohen and Gregory W. Welch
MIT Press, Cambridge, Mass., 1999. 279 pp. $40.00 hc ISBN 0-262-03263-5

Howard Aiken's place in the history of the information revolution is secured: His is the intellect that oversaw the birth of the first modern automatic calculating machine, known both as the Harvard Mark I and the IBM Automatic Sequence Controlled Calculator (ASCC). This nearly 5-ton electromechanical behemoth, conceived in 1937 and placed into operation in 1944, was the first realization of the class of engines, difference and analytical, described by Charles Babbage almost a century earlier. Aiken discovered Babbage's work only after having started on Mark I, and he developed a reverence for Babbage on realizing how similar was their thinking.

I. Bernard Cohen, the Victor S. Thomas Professor Emeritus of the History of Science at Harvard University, is uniquely positioned to document Aiken's contributions. They were colleagues for much of the period, 1935 to 1961, during which Aiken was a faculty member at Harvard. Cohen states that he was motivated to write *Howard Aiken: Portrait of a Computer Pioneer* while editing the companion collection of technical essays and reminiscences on Aiken's accomplishments *Makin' Numbers: Howard Aiken and the Computer*. Although Aiken's work has been well recorded, Cohen felt that the man himself was not adequately represented and that his place in history was undervalued. He conducted a two-day oral-history interview with Aiken a few months before Aiken's death, and he views this *Portrait* as a medium for promulgating Aiken's rich personal history and thinking.

The book focuses on the events surrounding the effort to build, staff, program and promote the use of the Mark I computer, and on some of the problems the machine was used to solve. The machine itself is described in considerable detail, and there are shorter stories of the three later Mark machines.

The Mark I was engineered and built for Harvard by IBM at no cost to the university. The eminent Harvard astronomer Harlow Shapley had introduced Aiken to IBM's Thomas J. Watson Sr, after Aiken had failed to interest a more natural corporate partner, the Monroe Calculating Machine Co, in the project. Cohen documents Aiken's relationships with the IBM technical staff assigned to the project (who actually developed the engineering design with Aiken), with IBM management, with his colleagues, and with the Harvard administration. Cohen also describes, less succinctly than it could be told, the complex situation of two self-centered and uncompromising individuals—Aiken and Watson—and two institutions, one the wealthiest and arguably the most arrogant university in the country and the other on its way to becoming a multibillion dollar enterprise and the leading computer company in the world. The rancor that evolved from the Mark I dedication ceremony in 1944 over where the credit was due left scars that took many years to heal.

I believe that Aiken's failed relationship with IBM cost Harvard important IBM largesse in the corporation's donations in the mid-1950s to MIT (and to UCLA) of a large IBM 704 computer and an endowment to support the multimillion dollar facility. With Aiken's disinclination, an obviously natural relationship between the Harvard and MIT computing groups never developed. These events all but guaranteed an isolated Harvard computing program that could not compete at the leading edge. Cohen also documents the Harvard administration's lack of sympathy for Aiken's "empire building;" rather than facilitating and encouraging the computer science department, the university administration undermined it.

The appearance of the Mark I was a milestone in the evolution of the information revolution, but its successors (Mark II, III, and IV) and Aiken's thinking never really joined in the mainstream of ideas that were fomenting in the emerging computer-science community in the years immediately following World War II. Although Aiken foresaw a number of key general directions for computers, such as the shrinking size and increased power of future machines, he completely missed the importance and ubiquity they would achieve.

Probably his biggest failing was his inability to amalgamate into his thinking the ideas being developed elsewhere. Since he traveled widely and had contact with many of his contemporaries, he had every opportunity to do so, but his arrogance prevented it.

Finally, the book details Aiken's development of the Harvard program in computer science, his relationship with his students, life in the computer laboratory, his early retirement from Harvard in 1961, and his post-Harvard career as a successful entrepreneur and consultant. The recollections of those who worked with Aiken leaves us with a clear picture of a controversial, uncompromising, hard-driving man of action. He was a superb organizer, teacher, and leader. He was as demanding of others as he was of himself, but for the students and colleagues he respected, he was patient, considerate, and compassionate.

Cohen repeatedly praises Aiken's pedagogical talents, and deservedly so. Many of the first generation of computer scientists received Harvard doctoral degrees mentored by Aiken—16 during the period 1948 to 1958. And he established and continued to evolve a very strong syllabus for the discipline. In the long run, these are probably Aiken's most notable contributions.

One of Cohen's many interesting appendices, "Who Invented the Computer? Was Mark I a Computer?", introduces the handful of contributors who developed the modern computer during the approximately dozen years starting in 1940. He gives a rather succinct description of the contributions of John Atanasoff, J. Presper Eckert, John W. Mauchly, Maurice Wilkes, Konrad Zuse, and John von Neumann. He also suggests that the honor of the "invention of the computer" might go to Alan Turing or even Charles Babbage. The fact remains that all of these participants, and a good number of others less known, contributed to the intellectual ferment that gave rise to the computer and the information revolution.

The companion volume, *Makin' Numbers: Howard Aiken and the Computer*, edited by Cohen and Gregory W. Welch with the cooperation of Robert V. D. Campell, is interesting in its own right. It contains a collection of technical essays on Aiken's machines, including the specifications of all four Mark machines, some of Aiken's own writings, a chapter by Welch on the Harvard culture in which Aiken had to develop his program, and the personal reminiscences of a number of Aiken's students and colleagues. Some of these short reminiscences do a better job than Cohen's *Portrait* in conveying the sense of the man. In particular, I found the essays by Richard Bloch, Frederick Brooks Jr, Peter Calingaert, and Maurice Wilkes most interesting.

Cohen's attempt to enhance Aiken's place in the history of computing fails in that the community has already placed him precisely where his contributions have been made. But these two books nicely reinforce the significance of his contributions and enrich the historical record.

Alfred E. Brenner
Institute for Defense Analyses
Alexandria, Virginia

Computational Physics

J. M. Thijssen
Cambridge U. P., New York, 1999. 546 pp. $105.00 hc ($47.95 pb) ISBN 0-521-57304-1 hc (0-521-57588-5 pb)

The need to solve complicated physics and engineering problems was a critical factor that helped spur the development of increasingly powerful computers, beginning in the 1940s. It continues to drive the development of modern, massively parallel computers, whose speeds can exceed 10^{12} operations per second. The availability of fast computers, conversely, has changed the way physics research is conducted, expanding the scope of theoretical physics to encompass what is often termed "computational physics."

The growing importance of computational physics to physics research as a whole will depend not only on increasingly powerful computers, but also on the continuing development of algorithms and numerical techniques for putting these machines to use. Furthermore, physics departments will need to augment their curricula to provide students with the skills needed to perform research using computers; they will need not only courses in computer programming and numerical analysis, but courses as well that describe the specific algorithms and methods employed in contemporary physics research.

In *Computational Physics*, Joseph M. Thijssen has produced a book that is well suited to meeting these needs. The 14 chapters cover a broad range of topics in condensed matter physics, including such electronic-structure techniques as tight binding, Hartree–Fock, and density functional theory; classical and quantum molecular dynamics simulations; classical and quantum Monte Carlo techniques; transfer matrix methods; and methods for lattice field theories, where he appears to concentrate his attention. In addition, he briefly describes issues related to parallel computing, and, in two appendices, he discusses useful numerical techniques.

The author's approach is to introduce each topic with a brief exposition of the fundamentals, describe the algorithms and their implementation, and then illustrate the methods with one or two simple examples. He is careful to distinguish numerical approximations from the theoretical approximations needed to make a solution tractable, and he points out possible sources of uncertainty. Because of the wide range of topics, Thijssen has chosen to focus on the development and description of techniques, purposely avoiding lengthy discussions of results obtained using these techniques. He does, however, provide a list of 351 references in which the interested reader can find real-world results as well as in-depth discussions of the theoretical foundations underlying the techniques. Thijssen also points out similarities in the formalisms and underlying numerical