late Abraham Pais. Crease's involvement came at the request of Pais's widow, Ida Nicolaisen, who supplied her husband's notes after he died in 2000. Before moving to Rockefeller University in New York in 1963, Pais had been a professor at the Institute for Advanced Study in Princeton, New Jersey, during most of the 17 years that Oppenheimer was its director.

Both Pais and Crease have written well-received books on the history of science. For the Oppenheimer biography, Crease tried to follow the intentions of Pais, as inferred from his notes, without appreciable reorganization, and he has added four excellent supplemental chapters. The result is what C. N. Yang has called "a kaleidoscopic approach to [Oppenheimer's] life, shedding insightful light on [his] personality and times."

Pais's book begins by describing Oppenheimer's life through the 1930s, a cursory account based largely on secondary sources and on Thomas S. Kuhn's 1963 interview with Oppenheimer. Crease tries to identify the secondary sources but doesn't always succeed. I noticed some paragraphs that appear unaltered from Pais's own autobiography, *A Tale of Two Continents: A Physicist's Life in a Turbulent World* (Princeton U. Press, 1997). The chapter on Oppenheimer as a teacher at the University of California, Berkeley, in the 1930s consists mainly of a quotation from the Kuhn interview and a longer one from Robert Serber, who went there as Oppenheimer's postdoctoral assistant. For this earlier period of Oppenheimer's life, I prefer one of the recent excellent biographies such as *J. Robert Oppenheimer and the American Century* (Pi Press, 2005) by David C. Cassidy or *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (Alfred A. Knopf, 2005) by Kai Bird and Martin J. Sherman.

Oppenheimer's life in the 1930s aside from his physics is told partly in his own words, taken from his published testimony before the 1954 Personnel Security Board (PSB) hearings that led to the removal of his security clearance. At those hearings he identified Jean Tatlock, with whom he had an affair while teaching at Berkeley, as the person who first introduced him to left-wing friends and to political issues he had ignored earlier. In the fall of 1940, Oppenheimer married Katherine ("Kitty") Puening, with whom he had two children. Tatlock later committed suicide in 1944.

Only five pages are devoted to the period between 1939 and 1945, from the discovery of nuclear fission to the bombings of Hiroshima and Nagasaki. Yet nine pages of small type present the full text of Oppenheimer's farewell address at Los Alamos on 2 November 1945. Pais regarded the address as an important scientist's credo. It does not offer an optimistic view of the future of nuclear weapons or their effective control. Presented in Oppenheimer's lofty style, the speech seems dated and overly preachy.

Pais offers a full account of the Institute for Advanced Study's history, included Oppenheimer's directorship and the institute's conflicts and academic politics. He gives a rundown of Oppenheimer's role in important postwar physics conferences and includes vignettes of notable participants (some of whom were permanent residents of the institute). He also covers Oppenheimer's sometimes unfortunate interactions with them. Pais presents brief testimonials from well-known physicists regarding Oppenheimer's superb directorship over wartime Los Alamos. Such treatments in the book are examples of the kaleidoscopic approach that Yang refers to. Lengthy excerpts from Oppenheimer's many public lectures tend to be repetitive.

The remaining part of Pais's book, as distinct from Crease's supplemental material, deals with the politics of nuclear proliferation from the early postwar years until the start of Oppenheimer's fateful 1954 security hearing. Pais felt that Oppenheimer's major influence on public policy reached its zenith in 1946 in the Acheson–Lilienthal report, largely the work of Oppenheimer, which proposed that a new international agency be established to control nuclear weapons and promote the use of nuclear energy. Bernard Berenson was chosen to make the proposal to the United Nations, but it was doomed from the outset because of the mutual distrust between the West and the Soviet Union. After that episode, Oppenheimer became a hardliner on the Soviet Union—not a pacifist, as some have mentioned. Yet he preferred tactical nuclear-fission weapons to the hydrogen bomb, which would be useful only for destroying large cities. His position brought him into conflict with US Air Force officials who favored a strategy of massive retaliation. It also led to his downfall.

In the supplemental material, about one-quarter of the book, Crease gives a masterful account of the PSB hearings that began on 12 April 1954, demonstrating that they were largely show trials whose purpose was to undermine Oppenheimer's prestige and diminish his political influence. Oppenheimer's consulting contract with the Atomic Energy Commission would, in any case, have terminated in June—and it need not have been renewed. Crease reports the reactions of various observers—scientists and others—to Oppenheimer's "trial," including post mortems on his testimony (which many felt was inadequate) and judgments on Oppenheimer as an emotionally charged, cultural symbol. He describes Oppenheimer's public life after the hearings as that of an "insider in exile." Crease's exceptionally clear, objective, and moving story will appeal to most readers.

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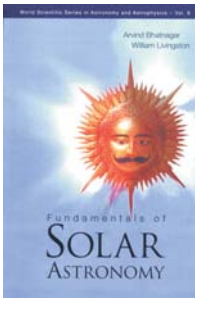
Fundamentals of Solar Astronomy

Arvind Bhatnagar and William Livingston
World Scientific, Hackensack, NJ, 2005. $58.00, $32.00 paper (445 pp.). ISBN 981-238-244-5, ISBN 981-256-357-1 paper

Like most areas of astronomical research, the study of our Sun is now a multi-wavelength enterprise involving a diverse group of researchers with expertise in various instrumental, analytical, and theoretical techniques. With the public's excitement over dramatic satellite images from space, it is easy to forget that only a few decades ago the field was almost entirely dependent on ground-based observations in the visible part of the electromagnetic spectrum. Arvind Bhatnagar and William Livingston's *Fundamentals of Solar Astronomy* is a welcome reminder by two distinguished solar-optical astronomers of the important role that those ground-based observations have played and continue to play in solar research.



According to the preface and back cover, the book's purpose is to stimulate interest in studying and observing the Sun and to bridge the gap between books that provide elementary information about the Sun and advanced texts on solar astrophysics. The authors state that their book is primarily aimed at university students and amateur

astronomers who are "starting to study the Sun and want to pursue an advanced course in solar physics, but lack the basic knowledge of solar astronomy." However, they do not pursue the careful pedagogical development that is the hallmark of a good textbook. In fact, it is best not to read it from beginning to end: The level of exposition ranges from informal to difficult. Although it contains few equations, the reader will need to have mastered basic physics and have a good knowledge of astronomy, optics, and calculus to follow much of the text. A glossary helps with the terminology. The English in the book is not uniformly correct, but the authors' intent is generally clear.

The book's packaging is quite attractive. Its front cover displays an intriguing image of a Sun god from India; the back shows pictures of Bhatnagar, who passed away in May, and Livingston. The text contains many photographs, illustrations, and graphs, some in full color. The first chapter, "Ancient Solar Astronomy," provides an interesting compilation of ancient mythologies and observatories from around the world—from the Middle East and Asia to the Americas and Europe. However, the text reads like a concise encyclopedia. Additional references would have been helpful for readers seeking more information.

Chapter 2, "Modern Solar Observatories," is also encyclopedic in nature. The sections on ground-based, optical facilities and current space missions are reasonably comprehensive. But in the section on solar-radio observatories, many major facilities, such as the Nançay Radioheliograph in France and the New Jersey Institute of Technology's Owens Valley Solar Array in California, are surprisingly absent. Chapter 3, "Structure of Solar Atmosphere," is primarily about the solar interior, and I would have combined it with chapter 9, "Solar Interior and Helioseismology." Chapters 4 and 5 cover "The Quiet Sun" and "The Active Sun," respectively.

Readers need to be on alert for occasional errors. In chapter 3, for example, g, the gravitational acceleration, appears in the ideal gas law. Also, the authors incorrectly state that "conduction occurs only in solids and is irrelevant for stars and Sun." After the authors correctly show that the gyro-frequency is independent of density, chapter 4 contains the statement "The gyro-frequency of radio emission is a function of density and magnetic field strength."

Chapters 6 through 8 address "Observational Techniques," "Solar Optical Instrumentation," and "Solar Eclipses," respectively. Those chapters include such practical issues as evaluating and determining the orientation of the Sun, the position of the Sun's features, the types of solar-optical telescopes, and eclipse seasons and paths. The authors also offer a section on determining the gross properties of the Sun (distance, mass, luminosity, and so forth), as well as technical sections on optical filters and different measures of temperature. Although the authors cover a range of topics, their emphasis and greatest strength are in the area of ground-based, solar-optical astronomy. The final chapter, "On the Joy of Observing the Sun—A Personal Experience," is a delightful, approximately two-page essay that I would have placed at the front of the book.

Bhatnagar and Livingston frequently make the case for the continued value of observing the Sun with the human eye. The book presents fascinating comparisons of the detail in historic drawings of the Sun with modern high-resolution photographs. Chapter 8 encourages first-time solar-eclipse observers to leave their cameras at home and experience the sensations of an eclipse. Moreover, it includes a list of phenomena that can be observed with no more than a dark filter.

Fundamentals of Solar Astronomy could have been more effective for students and amateur astronomers. Nevertheless, it contains useful, interesting information for all readers. The authors' personal comments are priceless, and I am glad to have their book available on my shelf.

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Physics Demonstrations

A Sourcebook for Teachers of Physics

Julien Clinton Sprott
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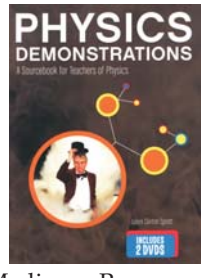
ISBN 0-299-21580-6, DVDs



Julien Clinton Sprott is one of the great physics showmen of our time. Since 1984 his lecture and demonstration program series, "The Wonders of Physics," has been presented yearly at the University of Wisconsin–Madison. Program features have included a grand entrance