how much of the true signal has been captured. I agree with Markgraf and Diaz that multi-proxy reconstructions are the best hope for resolving uncertainties. Still, it is noticeable that the multi-proxy evidence presented here does not pick up the biennial power evident in the modern record. What else is missed?

The book is beautifully produced with high-quality paper. I found relatively few typos, incorrect references, or other technical errors. However, more informative captions would allow the figures to be interpreted without the reader having to sift through the text.

The editors express the hope that this book makes a contribution toward a broader understanding of the ENSO phenomenon, by providing an updated synthesis of some of the significant accomplishments toward this goal, and by highlighting some of the areas where gaps in our knowledge still exist. Their hopes have been realized.

Reviewer

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Ionospheres: Physics, Plasma Physics, and Chemistry

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R. W. Schunk and A. F. Nagy
Cambridge University Press, N.Y., xvi + 570 pp., ISBN 0-521-63237-4, 2000, $100.

Good books on space physics are hard to find. Instructors teaching courses in this field often must pull material from many books, papers, and other resources to compile a useful set of lecture notes. There is also the task of developing homework sets and test questions. Developing appropriate problems for a graduate-level course is one of the most difficult tasks facing an instructor. Therefore, when a good, inclusive book comes along, it is a noteworthy occasion and should be celebrated by the community.

Such a book is now available. *Ionospheres: Physics, Plasma Physics, and Chemistry* is a milestone publication that covers the fundamentals of the ionized gases that coexist with the upper atmosphere. The book is the result of decades of work and courses taught on this subject by two heavyweights of the field, R. W. Schunk and A. F. Nagy. It systematically presents a comprehensive collection of what is needed for a deep understanding of this topic.

The book begins with a brief historical perspective followed by a general discussion of solar system physics and how planetary ionospheres fit into the larger scope of space science. This chapter is packed with both qualitative and quantitative information covering the basics of the field, and it doubles not only as an overview for the beginning graduate student, but also as a worthwhile refresher for their professors and as an introduction for scientists unfamiliar with this field. While these two chapters are without equations or problem sets, the book gets serious from here to the end.

After the introductory material, it launches into five mathematically detailed chapters, which discuss the physics of transport and wave processes in the ionosphere. Illustrations are limited, but they are efficiently chosen to clarify those points that require a picture for full comprehension. The focus is primarily on the terrestrial ionosphere, but the information is certainly applicable to all of the other ionospheres in the solar system and to plasma physics in general. The 44-page chapter on wave phenomena and interactions is extremely illuminating and thoroughly initiates the reader to this topic. Advanced calculus and a grasp of partial differential equations are probably prerequisites for a course that attempts to teach the rigorous mathematical presentations in these chapters. However, an instructor could feasibly teach around the more difficult sections without loss of meaning and simply refer the interested student to the text.

The remainder of the book has many equations, schematic drawings, as well as plots of observational data and theoretical results. Covering topics such as neutral atmospheric processes, energy deposition, sources and losses and the unique behavior of various ionospheric regions, this part of the book lays a fundamental foundation on which to build a career in space physics. The final two chapters on planetary ionospheres and measurement techniques are brief overviews of these vast topics, and their brevity reflects the book's focus on terrestrial ionospheric physics. Their inclusion is important, however, as the first provides an excellent comparative analysis and the second provides a quantitative discussion of the methods used to observe the ionosphere. The absence of a problem set at the end of the final chapter is unfortunate but reflects the theoretical leanings of the authors.

Two particularly useful aspects of the book are the problem sets and the appendices. The many diverse questions at the ends of the chapters challenge the reader to critically apply the essential skill sets covered in each section. These will be valuable not only as ready-made homework sets, but also as starting points for developing additional problems. The 55-page appendices consisting of tables and formulas and extra material add significantly to the value of this book as a text for graduate students, as well as a reference for long-time researchers in the field. Some are self-explanatory tables, while others contain sufficient text to make the equations and numbers understandable. The book is an excellent compilation of basic material e ssential to ionospheric physics.

The Cambridge Space Science series contains a growing list of books with high relevance to geophysics. *Ionospheres: Physics, Plasma Physics, and Chemistry* is no exception. This excellent book's utility as both a graduate-level textbook and reference book for active researchers fills a much-needed niche in presenting the expansive topic of ionospheric physics and chemistry. It relates to the reader the passion these two scholars have for the subject.

Reviewer

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About AGU

Merton Davies (1917-2001)

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Merton Davies passed away unexpectedly in April at age 83 due to complications from surgery. He will be remembered for establishing the prime meridian for essentially every solid planet in the solar system with the exception of Earth and Pluto. He was an AGU Fellow, and had been a member since 1970 (Planetary Sciences).

In cartography and geodesy, nothing is more fundamental than establishing the fiducial point to which all other measurements are related. For a planet, this is the location of the prime meridian—zero longitude. Upon this foundation is built the interconnected network of distance, angle, and time coordinates that tell one where one is and what time it is. Here on the Earth, contention for "ownership" of the prime meridian was for centuries a scientific, political, and commercial issue of great moment, before Greenwich finally became the choice of the world's maps. To have established the prime meridian for a single planet alone could be regarded as a major career achievement by any scientist—an instructive lens through which to view Davies' accomplishment.

Mert (as he was known to everyone) was also recognized by his colleagues as one of the true pioneers in developing and using space photography to study planets. However, few of his younger colleagues on the missions of the 1970s and 1980s were aware that Mert had already achieved legendary status in the military reconnaissance satellite program, long before he left the classified world to pursue planetary exploration.

He obtained his degree in mathematics from Stanford in 1938, just in time to be swept up in aviation development with Douglas Aircraft during World War II. In 1947, he became one of the first employees of the RAND Corporation. There, he contributed to the pioneering studies leading to CORONA, the world's first successful reconnaissance satellite. He was a member of the far-sighted RAND team that highlighted the potential of space well before October 1957, when Sputnik transformed that potential into reality. By 1958, Mert had authored a RAND report on how to take pictures of the Moon from a spin-stabilized spacecraft. In 1962, he was part of the team that interpreted the alarming U-2 images of new Cuban missile sites. In 1964, he was awarded a patent for a space reconnaissance camera utilizing the spin/pan approach for wide-angle mapping. In 1966, he won the George W. Goddard Award for distinguished contributions to photo reconnaissance. In 1999, the National Reconnaissance Office in Washington, D.C. honored him as one of the founders of national reconnaissance.

Mert's "second career" began in 1963, when planetary exploration was in its infancy. Mert began a long-term collaboration with one of us (BCM), with the ambitious goal of conducting nothing less that the photo reconnaissance of the solar system. This led directly to developing techniques for space imaging and mapping and his involvement with the camera team for the Mariner 6 and 7 missions to Mars. From then on, Mert was a key team member of virtually every major planetary mission: Mariner 9 to Mars; Mariner 10 to Mercury; Voyagers 1 and 2 to Jupiter, Saturn, Uranus and Neptune; Galileo to Jupiter; NEAR-Shoemaker to Eros; and Magellan to Venus. It was Mert who invented the photogrammetric control point technique that provided the basic framework for all planetary surface mapping and coordinates systems. His fundamental contributions to planetary mapping led to long service on the International Astronomical Union committees that name the surface features of Mercury, Venus, Mars, and the satellites of Jupiter, Saturn, Uranus, and Neptune.

Mert was a great human being. Tall and lanky, always with a gentle smile (really a barely suppressed giggle most of the time), he always had time to encourage, teach, and generally share his tremendous enthusiasm for exploration with everyone, young and old, junior or senior, distinguished peer or interested citizen. Members of the exploratory missions to which he contributed always benefited from his presence. Mert's persistent efforts to squeeze out intriguing clues about the shapes and motions of planets and their satellites paid dividends in scientific discoveries across many disciplines. Everyone valued his generous friendship. Although he never taught formally as a member of a university faculty, multitudes of students came in contact with him, and are the richer for it. A quiet dinner with Mert and his wife, Louise, anywhere in the world was an event to be treasured, both for good fellowship and for stimulating conversation. He truly was the personification of "unselfish cooperation in research" and was legendary for his willingness to share freely data and ideas with all his colleagues.

He was actively contributing to several projects right up to his final illness. We and the geophysics community will miss him terribly. Truly, Mert Davies was a special person who contributed in a major way to extraordinary times. His passing marks the loss of one of the pioneers of the space age, who was there from its inception and was responsible for fundamental techniques and results we now take for granted. His influence on our memories, our maps, our science, and on generations of researchers will live on after him.

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