

Book Review:

Physics and Chemistry of the Upper Atmosphere

The recently published book, *Physics and Chemistry of the Upper Atmosphere*, by M. H. Rees, is now available through Cambridge University Press, London. Sushil K. Atreya, University of Michigan, Ann Arbor, provides this review.

The Earth's upper atmosphere is a region of immense complexity. The behavior of this region is governed primarily by the energy deposited by solar ultraviolet photons and the energetic charged particles. This book is an excellent attempt at unraveling the mysteries of the upper atmosphere of the Earth. The upper atmosphere in this book refers loosely

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to the region of the thermosphere and ionosphere, although it is not uncommon to find, throughout the book, occasional references to the mesospheric processes.

The book is divided into eight chapters that deal with the actual process of energy transfer in the low, middle and high latitudes, followed by the manifestation of such energy transfer in terms of compositional changes, thermal structure, spectroscopic emissions and the atmospheric dynamics. All of the chapters contain an in-depth treatment of the physical principles and the chemical processes (when appropriate), as well as a comprehensive discussion of observations from ground-based, orbital and suborbital instruments. At the end of each chapter, most important references are cited for further reading. Each chapter also lists representative problems that will provide graduate students with enough needed exercise to think independently. Students planning to take Ph.D. comprehensive examinations in aeronomy will be well advised to work through all these problems; I found many of these problems quite challenging. The appendices at the end of the book are quite thorough, as they contain most of the aeronomically pertinent information on model atmosphere, solar fluxes, cross sections, chemical kinetics, atomic and molecular physics, and the atmospheric diffusion.

Four chapters are particularly informative and well written and clearly show the author's insight into those areas (other chapters contain mostly standard material and should be an integral part of any monograph on aeronomy). Chapter 3, on charged particle impact, and chapter 6, on energy balance, reflect the author's pioneering work in these areas, although important work of others is cited also. Chapter 7, on spectroscopic emissions, will be very valuable for observational aeronomers and is a much needed update to similar chapters in J. W. Chamberlain's *Aurora and Airglow*, written in the early 1960s. My only complaint for chapter 7 is that little attention is paid here to the high-resolution UV and visible spectroscopic work.

Chapter 8, on thermospheric dynamics, presents a well-balanced discussion of modern observational techniques for measuring thermospheric winds and the ion drifts, such as chemical release, doppler-shifted emissions, incoherent scatter radar, etc., and the theory. Those not closely related to this important area of aeronomy will find this chapter a good tutorial.

In summary, I find this book to be an excellent reference for researchers in the field of aeronomy and graduate students who are planning to study aeronomy.