Wonders of the sky

Mark Saunders

The Solar–Terrestrial Environment. By J. K. Hargreaves. *Cambridge University Press: 1992. Pp. 420. £50. $79.95.*
The Aurora: Sun–Earth Interactions. By N. Bone. *Ellis Horwood: 1991. Pp. 156. £38, $65 (hbk); £15.95, $27.50 (pbk).*

INTEREST in our solar–terrestrial environment (geospace) predates recorded history, but the main advances in knowledge have come since the dawn of the space age 35 years ago. The physics of this region, which consists of the Earth's upper atmosphere and magnetosphere, depends critically on the Sun and the solar wind. Ultraviolet radiation from the Sun photo-ionizes gases in the Earth's higher atmosphere, creating a zone of ionization called the ionosphere at altitudes ranging from 60 km to more than 300 km. The solar wind, a tenuous (5 particles cm^{-3}), fast-flowing (400 km s^{-1}), highly electrically conducting plasma blowing continuously out from the Sun interacts with the Earth's magnetic field in subtle and complex ways. These interactions generate more than 5×10^{11} watts of power that drives the many physical processes, including aurorae, in the magnetosphere. Despite the considerable progress made over the past 35 years, few readable advanced-level texts have appeared. This deficiency is now partially remedied with the publication of these two books.

The textbook by J. K. Hargreaves is attractively produced, well illustrated, readable and interesting. It is intended for final-year undergraduates and first-year postgraduates taking courses in upper-atmospheric, ionospheric or magnetospheric physics. Mathematics is kept to an elementary level, the intention being to describe the basic concepts. To this end, the author has done a good job, and the book is a more thorough and improved version of his previous volume *The Upper Atmosphere and Solar–Terrestrial Relations*, first published in 1979. The new book is sensibly divided into ten chapters, the first three introducing the basic physical principles and techniques for observing geospace. The main part of the book covers the neutral and ionized upper atmosphere and the magnetosphere and their associated structures, dynamics and disturbances. The text concludes with a brief chapter on technological applications.

The book does, however, suffer slightly from reflecting the special interests of the author instead of providing a coherent coverage of the subject as a whole. In particular, only one chapter is devoted to the solar wind and the magnetosphere, whereas the ionosphere receives three full chapters. And the material often seems a little outdated, failing to convey the true scope and excitement of present-day research. There are few recent references and no discussion of the many planned future developments.

Mary Evans

Auroral evidence — the aurora borealis as depicted in *Physique Populaire* (*c.* 1850).

Of the many fascinating phenomena in solar–terrestrial physics, aurorae are the most special for they can be observed without scientific instruments and have evoked awe and admiration for as long as Earth has been inhabited. The name 'aurora borealis' was suggested by Gassendi in 1621 and means 'northern dawn'. Its counterpart in the Southern Hemisphere (the aurora australis, or southern dawn) was predicted by de Mairan in 1731 and first recorded by Captain Cook in 1773. Our understanding of the aurora has developed slowly, and even today there remain important questions that are the topic of much research. *The Aurora* is an attempt to fill a notable gap in the literature. Most existing texts on the aurora are written for popular consumption or are suitable only for experienced research workers. This book bridges these extremes by providing a text accessible to amateur and professional astronomers, but also containing introductory material useful to research workers in solar–terrestrial physics. It reviews the new observations of the aurora made from satellites and from a variety of ground-based stations.

The book is readable, adequately illustrated and well referenced. The attractive colour 'mini-atlas' of auroral types and forms is particularly welcome. There are detailed descriptions of the different types of aurorae (polar, mid-latitude, radio aurora) and information on related high-atmosphere phenomena such as noctilucent clouds and airglow. Useful practical advice on auroral observations is also included.

Unfortunately, only a cursory description of the mechanism(s) behind the aurora is given. The bright, highly structured auroral forms such as arcs and rays are produced by the acceleration of electrons to energies of 1–10 keV at altitudes around 10,000 km. How this acceleration occurs is one of the most controversial topics in space physics and surely deserves mention. Most believe that decreases in electric potential parallel to the Earth's magnetic field lines are the cause, but new satellite observations (including those from the successful Swedish auroral probe Viking, which is surprisingly not mentioned in the text) are now causing many to question this opinion. □

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Physics textbooks

■ *Newton to Einstein: The Trail of Light* by Ralph Baierlein. "An excursion to the wave-particle duality and the Special Theory of Relativity" for undergraduates, with emphasis on pivotal experiments. Biographical and historical sketches, and many exercises, complement the text. Cambridge University Press, £24.95, $34.95.

■ *Introducing Einstein's Relativity* by Ray D'Inverno. Aims to provide students with a mathematical introduction, complete with many exercises. Clarendon/Oxford University Press, £22 (pbk).