

mathematical rigor and detail that was evident throughout his research efforts.

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## Planetary Sciences

Imke de Pater and  
Jack J. Lissauer  
Cambridge U. Press, New York,  
2001. \$75.00 (528 pp.).  
ISBN 0-521-48219-4

The field now known as planetary science has a common origin with all of quantitative science and shares founding figures such as Isaac Newton, Pierre Simon de Laplace, and Joseph Louis Lagrange. The study of planets, however, gradually became a backwater of astronomy and astrophysics during the first half of the 20th century, when planets did not readily yield their secrets.

But the second half of the century changed all of that: detailed data from spacecraft and powerful telescopes, along with advances in computer technology, produced an explosive renaissance. Planetary science became profoundly interdisciplinary and incorporated modern fields ranging from astrophysics and geophysics to biochemistry and chaos theory. But it grew far faster than its expository literature, texts, and monographs.

There is still a dearth of good texts covering the entire field. Imke de Pater and Jack Lissauer laudably address this problem directly with their encyclopedic *Planetary Sciences*. De Pater is an astronomer at the University of California, Berkeley, who observes planets at wavelengths from visible to radio; Lissauer, from NASA's Ames Research Center, is primarily known for his theoretical research on rings and solar system origins. Although both are prominent in their fields, they freely admit that their book's breadth extends well beyond their expertise. They have been helped by an impressive list of colleagues.

*Planetary Sciences* is primarily intended for those who wish to dig into the subject quantitatively. Such seekers include graduate students in planetary sciences and related disciplines, upper-division undergraduates in the physical sciences, and practicing scientists seeking more details about the field or looking for interesting problems. The text does not shy away from equations, although it does not always offer a clear discussion of their origins.

It is not surprising, considering the authors' strengths, that the chapters on dynamics, atmospheres, magnetospheres, rings, and planet formation are strongest, along with sections on comet formation and the orbital properties of the Kuiper Belt and Oort Cloud. The chapter on rings (chapter 11) includes a nice presentation of shepherding and resonance effects, and would be a good place to start to understand density-wave theory.

How old are Saturn's rings? Shepherding theory and data seem to indicate that they must be much younger than the solar system, but chapter 11 shies away from accepting this result, perhaps hedging the bet until Saturn Cassini orbiter mission data come back in a few years.

De Pater and Lissauer don't do research on meteorites or planetary surfaces or interiors, so how satisfactory are those sections of their book? An earlier standard in the same subjects is John Wood's *The Solar System* (Prentice-Hall, 1979); it is laconic and out-of-date but still helpful and lucid (note that the second edition of Wood, 1999, has expunged all equations and thus no longer competes with the more quantitative surveys). *Planetary Sciences'* coverage of planetary interiors is workmanlike but not without mistakes.

In certain fields of planetary science, the information-doubling time is quite short, perhaps a couple of years, so how successful is *Planetary Sciences* in staying abreast of the tide? The best test of this is chapter 13, Extrasolar Planets, which covers a topic that is sure to explode in the 21st century. Only a half-dozen pages cover exoplanets; the material there is correct and nearly current, but one impatiently wants more details about the strange new perspective in which these new planetary systems cast our own Solar System. And bioastronomy, the search for life elsewhere in the Solar System, a topic still lacking an observational datum, gets little coverage. (*Planetary Sciences* wisely dodges a discussion of ALH84001, the putatively "bug"-laden Martian meteorite.)

Planetary science is an exquisitely visual field. It attracts many students by the impact of spectacular spacecraft images. The quintessential planetary image is the cratered surface, and it is important to convey to students the violent past that lies behind such an image. Unfortunately, illustrations are not the forte of *Planetary Sciences*. To keep the size and price down, the authors have mostly restricted their book to smallish, black-and-white line

drawings and photos, although a number of color plates are tipped in at the beginning. One figure reproduces a series of crater-density plots from now-classic work by Bill Hartmann on the cratering history of the terrestrial planets *Moons and Planets* (Thomson Learning, 1999). But de Pater and Lissauer's plots are too small and busy, and their explicatory text too disconnected, to do full justice to the fascinating story that they tell. So, for illustrations, I'd recommend J. Kelly Beatty, Andrew L. Chaikin, and Carolyn Collins Petersen's *The New Solar System* (4th ed., Sky/Cambridge U. Press, 1999). It is pitched at a lower level than *Planetary Sciences* (no equations), but each chapter, written by an expert in the relevant discipline, is reasonably rigorous.

I teach planetary sciences to graduate students and senior-level science majors. Would I use *Planetary Sciences* as a text? Yes, almost certainly. It is a massive achievement, and the well-considered problems and exercises at the end of each chapter will be particularly useful to students and to test one's own understanding.

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