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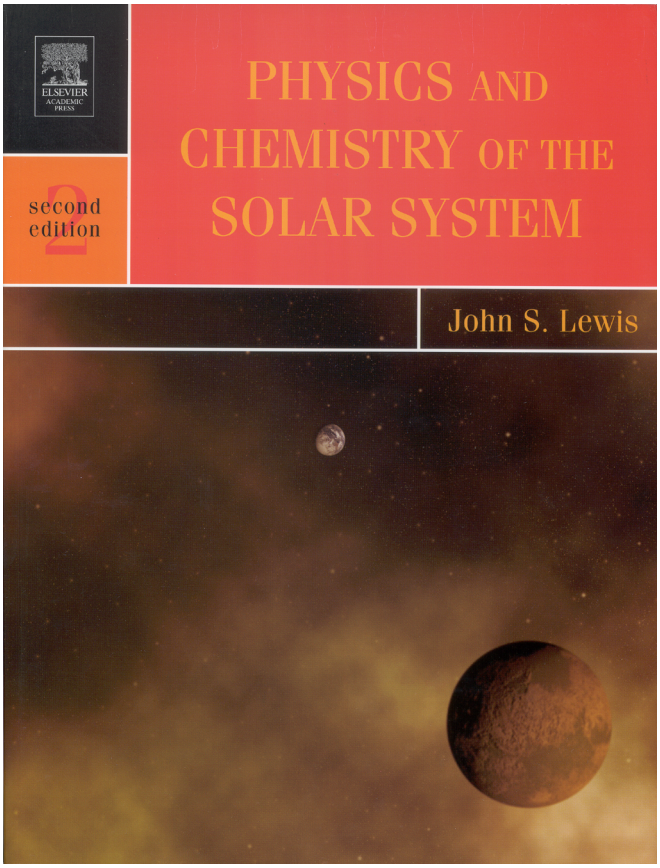
Book Review

Physics and chemistry of the solar system, 2nd ed., by John S. Lewis. Elsevier/Academic Press, 2004, 655 pp., $74.95, softcover. (ISBN 0-12-446744-X)



In the past few years, quite a number of books that discuss the solar system and planetary science have been published. This is quite a contrast to preceding decades, during which only a handful of planetary science books—with the exception of some popular works—had been published. This has changed recently, with the publication of a variety of textbooks, including, for example, *Solar system evolution* by S. R. Taylor (2001), *Planetary sciences* by I. de Pater and J. Lissauer (2001), *The Cambridge guide to the solar system* by K. Lang (2003), or *An introduction to the solar system*, edited by N. McBride and I. Gilmour, and half a dozen others, not even counting the more specialized books that only treat parts of the planetary system. It seems that our science is alive and well when we can chose among such an embarrassment of riches. And to this has now been added the second edition of John Lewis' book *Physics and chemistry of the solar system*, the first edition of which appeared in 1995. Despite the title, which implies a more restricted treatment of the subject, this book covers a wide range of topics in the planetary sciences.

The books devoted to the solar system that are now available allow one to choose from highly technical textbooks with plenty of mathematics, black-and-white line drawings, and extensive tables on one hand and, on the other hand, books with a profusion of color pictures taken by the newest satellite missions that try to explain everything in the most basic terms. Lewis book falls firmly in the first category. The first differential equation appears on page nine and the first integral on page 11 (not bad, considering that the first six pages are a short introduction and description of the book). Thus, those who either are not interested in or who do not need a mathematical treatment do not need to bother with this book. It treats its subject in a rigorous and equation-rich way; however, I am reminded of the saying that expressing something in equations instead of in words (prose) does not make it any more correct. Students might be lured into the assumption that everything that is described in this book is the final word on a topic just because it appears in exact and mathematical, but in fact we are just looking at our current state of knowledge, which can change quite drastically (and has indeed done so in the past).

This book has twelve chapters, four appendices (and it is no coincidence that the first one of them is a concise summary of equilibrium thermodynamics). The volume starts with an introduction, followed by a chapter called "Astronomical Perspective." This chapter contains such diverse topics as the big bang, stellar classification, star formation, star clusters, distance scales, and nucleosynthesis—all very important and worthwhile topics. Chapter 3, "General Description of the Solar System", is next, followed by a very detailed chapter "The Sun and the Solar Nebula," which not only contains an overview about our Sun, but also a detailed treatment of certain aspects of the solar nebula, concentrating heavily on equilibrium condensation of the elements and compounds. This might be a section which is a bit too detailed for its own good, as modifications to the hypothesis of equilibrium condensation and new developments have appeared during the past couple of decades, changing the view of how important this process really was. Chapter 5 covers the major planets (i.e., Jupiter, Saturn, Uranus, and Neptune), chapter 6 describes Pluto and the icy satellites of the outer planets,

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chapter 7 deals with comets and meteors, and chapter 8 with meteorites and asteroids. It is always interesting to see how authors group topics, but I found it odd that meteors are not described together with meteorites. However, good arguments can be made for both choices. The next chapter deals with the airless bodies: Io, Phobos, Deimos, the Moon, and Mercury. Chapter 10 is on the terrestrial planets: Mars, Venus, and Earth, and is followed by chapter "Planets and Life around Other Stars." The final chapter "Future Prospects" is short—mainly describing possible future spacecraft.

As for the four appendices—the first one being mentioned above—the second one is on absorption and emission of radiation by quantum oscillators and the third gives a detailed list of space missions that have explored the solar system, but, with one exception, it oddly ends in 2001. Appendix 4 is a short one with basic physical constants and number 5 deals with gravity fields. A list of suggested readings follows, though no reference list as such is included, and there is a useful nine page index. Each chapter has a long list of exercises, but unfortunately the answers or solutions are not given anywhere, diminishing their usefulness.

Almost everything that is of interest and importance in the planetary sciences is covered in this book, although some topics get surprisingly short shrift. There is almost nothing about the history of solar system studies (from the Greeks onwards), planetary astronomy (phenomenology), Kuiper belt objects, or impact craters and impact cratering (a couple of pages are wedged in between subsections on Io (!) and our moon). Some topics are found in what I consider an odd place or context. Also, the order of chapters or topics seems a bit unusual. It escaped me, for example, why Mercury is not covered with the terrestrial planets, why Pluto is covered together with the (icy) satellites of the outer planets (which liberates Io for another chapter) but not with the Kuiper Belt objects, and what the association of Io, Phobos, Deimos, our moon, and Mercury is that justifies lumping these diverse bodies together into one chapter—before discussing the terrestrial planets (sans Mercury).

There are only few black-and-white photographs in the book and just eight color pictures in a separate section (though their selection is somewhat random), which is a pity given how photogenic the objects of the planetary system are. The lack of pictures is lamentable because our understanding of solar system objects is greatly aided by all the nice images returned by spacecraft. But then again, the book is called *Physics and chemistry of the solar system*, not *Planetary geology* or *Planetary sciences*. There is, however, an abundance of line diagrams. These are mostly well-conceived and useful, but often very busy and with small labels. The subsection on lunar geology is one page long. There is one paragraph on the giant-impact hypothesis for the formation of the moon. There is not a single thin section photo of a meteorite or a lunar rock. The chemistry of the Moon gets one diagram. A well-balanced treatment of the solar system it ain't.

So where does this leave us? The book is well-written and the text flows easily, where not interrupted by equations. Certainly this book will be of great value as additional reading for advanced planetary science courses (mainly for students specializing in astronomy, astrophysics, and physics), but I would hesitate to use it as the sole textbook because of the unbalanced treatment of the subject. I would not recommend it in undergraduate or other introductory classes on planetary science; geologists will be scared away by the abundance of math. The price is high for a paperback, but, given the size of the volume, it is not unreasonable. Certainly most researchers and advanced students of the planetary sciences will find this to be a valuable volume.

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