**Fundamental Planetary Science : Physics, Chemistry and Habitability** by Jack J. Lissauer and Imke de Pater, pages 583, Cambridge University Press, 2013, Price $60, ISBN: 9780521618557 **(paperback).**

Given the key role played by planetary science in the programs of the principal national space agencies, it is not surprising to see a blossoming of books on the topic. *“Fundamental Planetary Science”* is a major document, explicitly intended as a university manual at the senior undergraduate and graduate levels. Were I teaching such a course, I would indeed recommend this encyclopedic text to my students, but with significant reservations. However, in a review intended for amateur astronomers, I must emphasise that this book is not an easily accessible oracle. Indeed, the text has a certain “Jekyll & Hyde” quality about it.

*“Fundamental Planetary Science”* comes across as a “third edition” of the authors’ book *“Planetary Sciences”* (2001 and 2010). The 2001 book was focused on concepts and processes. The current book is a strange mix of the same approach with a somewhat re-arranged content, plus added chapters on specific planetary bodies and misplaced intellectual meanderings on life thrown in for good measure. The authors appear uncertain on where they want to take this new text, and make the mistake of trying to be all things to all readers – likely within imposed publishing constraints.

Whereas the 2001 book was perhaps overly quantitative, it was at least linear. This rewrite is now a mix of tough slogging through, for example, the opaquely presented first year university math that peppers the early chapters on dynamics, physics and astrophysics, solar heating and energy transport, and planetary atmospheres, and the bulk of the book that presents a mostly prose-based, dogmatic and, in my opinion, out-dated view of our Solar System. If you are looking for a refresher course on the quantitative details of orbital mechanics and dynamics, tides and tidal heating, thermodynamics, black body radiation, adiabatics etc, you will find it here. However, chapters focused on the geoscience of planetary surfaces and interiors, the terrestrial planets and the Moon, planetary satellites, minor planets and comets, left me thirsting for more input from the authors. In part, these latter chapters contain errors in geoscience knowledge, in part they are so cursory that a lay-person will have trouble following the threads – for example, the section on tectonics.

More critically, the authors tend to present only the predominantly accepted geoscience concepts and are either unaware of - or choose to ignore - many of the exciting recent and ongoing debates (some quite lively) regarding our appreciation of how planets (especially our own) and moons in our Solar System work. For example, despite their obvious understanding of the influence of pressure on the physical states of planetary mantles, the authors continue to present the classical mantle plume model throughout the book as though there were no alternative view (there is !). They repeatedly attribute plate tectonics to a mantle convection driving force, whereas current thinking favours drive by slab sinking at subduction zones. They make no mention of the plate tectonic analogy identified on Saturn’s ice moon Enceladus, while misidentifying features on the Jovian ice moon Europa as resembling mid-ocean ridges. Water in volcanic minerals on the Moon that raised questions regarding the impact origin of our satellite; the debate regarding an ancient northern ocean on Mars and the identification of an oceanic shoreline; challenges to the endogenous origins of coronae and plateaus on Venus – these are not even mentioned, let alone critically evaluated. All linear features on rocky planets and ice moons are dutifully ascribed to crustal extension, with no critical appraisal of the consequences for the global radius of these bodies. Even a brief glance at the gravity-topography-crustal thickness relations for Mars, illustrated in the book, shows that the stated close connection between these, and the consequent simplistic interpretation, requires re-evaluation. The book recounts the impact model for the demise of the dinosaurs as though there was no alternative volcanically-related argument. The authors repeatedly refer to “terraforming” Mars, with no explanation of how to protect a renewed atmosphere in the absence of a planetary magnetic field; this is not science. I could go on, but you get the point. In all cases, the authors are uncritically presenting the current dogma. The overall result is a plodding listing of descriptions, and an absence of the excitement that should stem from recent and ongoing scientific debates.

Most disappointing was the chapter on planet formation. Without doubt it is a comprehensive, though disjointed, summary of the various processes and mechanisms that go into making planets and planetary systems. However, it almost seems to intentionally avoid drawing the threads together to describe – and critically evaluate – the most recent (now a decade old and still evolving), most exciting model for the formation and evolution of our own Solar System (comprising the “Nice” and the “Grand Tack” phases) : the only planetary system for which we have enough observational data to erect such a model, which also has implications for extra-solar systems. Throughout the book there are oblique references to giant planet migrations and their potential for impact on evolving planetary systems, but we are left wondering what it all means. If the authors wish to reject the model, then they should do so rather than ignoring it.

My take-home message is this : *“Fundamental Planetary Science”* is a great resource (and a bargain at the price) for those who either have access to excellent mentoring to fill the gaps and critically evaluate its errors, or who have an advanced understanding of planetary science and are looking for an encyclopedic reference work with an emphasis on physics and chemistry. I thoroughly enjoyed reading it : but you may not.

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