since those books were written. Specifically, it includes detailed discussions on tidal heating, spin-orbit coupling, planetary rings, resonances, chaotic dynamics, and symplectic integrators to name just a few topics. These are in addition to standard topics such as the two-body problem, the restricted three-body problem, disturbing functions, and secular perturbations. In all of these topics the authors take a perspective not found in the classical texts, emphasizing physics and *in situ* observations in addition to the mathematics of the dynamics. The chapter on the restricted three-body problem is a case in point, as it nicely ties together the basic facts of this model, advanced mathematical analysis of the problem, and physical examples of how this model is used (in conjunction with additional physical models in some situations) to understand a number of dynamical phenomena in the solar system.

In the preface, the authors state that this book should be seen as an extension of Roy's "Orbital Motion", and indeed this is an appropriate way to view the text. Comparing the content of these two books highlights some significant shifts that have occurred in the field of dynamical astronomy. Roy's book (as with most classic texts on dynamical astronomy) has chapters on observational geometry, orbit determination, and the theory of the motion of the Moon in addition to a number of basic and special topics. These traditional topics do not appear in Murray and Dermott's book, probably a first for a dynamical astronomy textbook, and instead they cover topics that involve physical processes at a fundamental level—topics that often were not even broached in the classical dynamical astronomy texts. The reason why this shift has occurred can be easily understood, given the vigorous exploration of the solar system that has occurred in the last few decades, yielding observations and measurements of such high accuracy that the ideal mathematical models of classical dynamical astronomy often no longer apply and must be augmented. Thus, the current text does not replace the classic texts but, instead, shows how the field of dynamical astronomy has expanded to the point where a new species of textbook has become necessary. Indeed, *Solar System Dynamics* represents this new species of textbooks in dynamical astronomy—and as the first in this new class it will surely be a classic for many decades to come.

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Astrobiology by Monica Grady. Smithsonian Institution Press, Washington, D.C., USA, 2001, 91pp., $14.95 paperback (ISBN 1-56098-849-5).

From an unimposing artistic interpretation of the Big Bang, to a photograph of an unidentified man leaning against fossilized algal stromalotites, to an explanation of optical chirality, Monica Grady presents a wide range of ideas with clear and concise language as an introduction to the field which shares a title with her book. Grady meticulously describes the mission of astrobiologists to understand extremophiles found across the globe and propose plans to search for similar life forms beyond the Earth. Her consistently fact-based approach, however, lacks development of potentially inspiring speculation about the implications of the ultimate goal of the astrobiologist's mission. Grady briefly mentions in the preface "the philosophers and theologians who are captivated by the range and depth of the subject matter" and, while the range and depth of the subject is carefully laid before the reader, discussion of why these studies should captivate a philosopher or a theologian is absent.

Grady admirably recognizes the line between knowledge and speculation unsupported by current understanding. The result is a clear presentation of the facts for a reader with little background in the subject upon which further questions and opinions may be formulated. At the same time, she offers a unique perspective as an expert in the study of meteorites. This perspective is most prevalent in the section regarding the origins of life on Earth, which may have been significantly aided by the contribution of organic material in meteorites. She also employs the very current knowledge of the Earth's diverse families of extremophiles while remarking that the extremes of conditions in which life is found on Earth may not represent the limits to conditions in which life has developed elsewhere. Similarly, Grady applies cosmology and astronomy to explain all known possibilities for extraterrestrial life, evidenced in her careful noting even of the indication that water-ice may exist on Mercury in areas of impact craters permanently shadowed from the Sun. Grady's approach to the subject, though its strengths are clear, sacrifices an invaluable opportunity to profoundly inspire the nonscientist reader by avoiding development of any ideas beyond the support of particular discoveries through telescopes, microscopes, and space missions. Two pages are devoted to the history of the naming of space missions and another to an exhaustive list of space missions to Mars, but the equally relevant issue regarding the social implications for a society that discovers extraterrestrial life is not addressed. The unique depth of the subject's social implications and the invaluable perspective a scientist with a career devoted to the subject might offer effects a risk of stepping beyond scientific expertise that is well worth taking.

Grady insures ease of understanding and enjoyment for a readership of diverse backgrounds with multiple diagrams, tables, and graphs and beautiful photographs on nearly every page. Assurance, however, of continued discourse when the book is set aside between an inspired reader and any willing ear is sacrificed in avoiding some of the deepest questions we can ask ourselves about the uniqueness of our role in the universe. Offering these questions and some related speculation in introductory books such as this one can assure

the spread of this speculation and subsequent inspiration of the public. Such an approach to astrobiology is needed to foster wide support for the science and the space exploration on which its mission depends.

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Moon Lander by Thomas J. Kelly. Smithsonian Institution Press, Washington, D. C., USA, 2001, 283 pp., $27.95 cloth (ISBN 1-56098-998-X).

Many readers of MAPS periodically write proposals for funding to NASA or some other national science support agency. *Moon Lander* is the memoir of the lead author on one of the most important funding proposals of all time. In 1962, a 100-page proposal by Thomas Kelly and his team managed to convince NASA to award the contract for building the lunar landing module (LM) to Long Island's Grumman Corporation, despite that company's limited previous experience with the space program.

Obviously, Kelly is a capable stringer of prose. Don't let the five page list of acronyms at the beginning fool you. This memoir is written in an approachable style, and if you have even a passing interest in space exploration it will grip your interest. It constitutes an important primary source for the history of human exploration. The culture of NASA and its contractors in the 1960s is documented from the perspective of a key actor in NASA's greatest triumph. After writing the winning LM proposal, Kelly went on to serve as Chief Engineer for most of the detailed design phase, and he was later (and not voluntarily, he admits) shifted to supervising the Manufacturing and Test operations.

The ungainly looking LM was the Kelly team's answer to a unique design challenge: a vehicle for transporting humans exclusively in airless space. Weight and safety were the overriding concerns. The book describes many difficulties that Kelly and his colleagues overcame in the detailed development of the LM. The LM's weight kept gradually creeping up between 1962 and 1965, as preliminary conceptual models for parts were replaced with actual prototype hardware. Draconian measures had to be implemented before the weight finally stabilized at about 15 tons (~1.5 times the initial concept).

In today's "tech" era, it is impressive to note that the Apollo hardware was designed when a high priority (and cause for "bragging within Grumman . . . for weeks") was acquisition of a few of IBM's latest "Selectric" typewriters. Throughout the book, Kelly implicitly acknowledges that he was merely one player on a colossal technology team. A great many other important people are described, thoughtfully and compassionately, including some colorful descriptions of Apollo astronauts. Kelly seems humble, and commendably frank about the mistakes he and his team inevitably made in their work. The Apollo 8 mission, which turned out to be a terrific success as a Christmas appetizer before the actual (July 1969) lunar landing, was only flown because Grumman was a few months tardy with delivery of the LM. It was tardy in part because Kelly had made a poor selection for the materials initially used for wiring and connectors.

The last few chapters of the book relate how during the Apollo landing missions Kelly and other Grumman personnel interacted with NASA to rapidly diagnose and overcome rare LM-related malfunctions, some of which occasioned great suspense. The LM won special renown when it served as the "lifeboat" for Apollo 13. Thanks to improvements in the Saturn V launch vehicle, the final three LM's were allowed to be heftier, and they packed a more powerful set of hardware for scientific exploration, including the lunar rovers.

This book is a flat-out good read. I recommend it highly.

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Noble Gas Geochemistry by Minoru Ozima and Frank A. Podosek. Cambridge University Press, Cambridge, United Kingdom 2002 (Second Edition), 286 pp., $80.00 hardcover. (ISBN 0-521-80366-7).

When my students have asked me for a good textbook about noble gases, the answer has always been, "Read 'Ozima and Podosek'. It is an excellent introduction and not too thick." Since quite a while, however, I have had to add, "Well, it has become a bit outdated, but there is no comparable more recent text." Now, after almost 20 years, the long-awaited second edition of this classic has appeared. I expected this to be a much thicker volume than its predecessor, since, in the authors words, "This discipline [noble gas geochemistry] was still comparatively underdeveloped [in 1983], and few people seemed to expect that this apparently arcane subject would become one of the major tools of geochemistry." Actually, however, this is still a concise book, inviting rather than discouraging reading. So, how did the authors manage to accommodate the tremendous amount of work over the last two decades? Basically by having produced an almost entirely new book. Most sections have been completely rewritten and the entire volume has been reorganized. Many of the highly useful data tables have been updated or replaced without considerable overall expansion. Of course, there are also