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

entirely new sections about topics largely unknown 20 years ago, such as cosmogenic noble gases in terrestrial samples. This is compensated by treating other topics more briefly now. One example is the search for paleoatmospheric noble gases in sediments, which received comparatively little attention in the recent literature. Another example is the discussion on models of the evolution of the Earth's atmosphere. So do not throw away your first edition of 'Ozima and Podosek' once you have bought the new one, however worn from use it may be!

The book contains seven chapters: "Introduction", "Physical Chemistry", "Cosmochemistry", "Water", "Crust", "Mantle", and "Noble Gases in the Earth". The first two are my favourites. Basic properties of noble gases and their behaviour in natural systems are treated in considerable detail and in a way hardly found in normal review papers. I would guess that newcomers and senior noble gas geochemists will equally profit from these chapters.

The authors' intention in the quite brief chapter devoted to cosmochemistry is not to provide a comprehensive review but "to focus on aspects most relevant as background to the study of terrestrial noble gases". This is certainly a defendable approach, although meteorite addicts might have preferred this section not to have become considerably shorter than in the first edition. I have to admit, though (with some frustration) that the summary of the short discussion on the origin of planetary noble gases in meteorites can hardly be contested: "The origin of planetary noble gases remains mysterious."

The chapters on the crust and the mantle have been essentially completely rewritten, with much new material added. The mantle chapter has become the longest one, reflecting the many new developments in noble gas mantle geochemistry. The last chapter mainly discusses what the composition of the primordial noble gases in the Earth may have been, as well as how they were acquired and subsequently modified. As these are hotly debated topics, one should probably not expect to find mostly answers that have obtained consensus acceptance, but the chapter provides insightful discussion of competing hypotheses. The chapter about water is the only one that has largely remained unchanged, apart from a new section on the paleotemperature record provided by noble gases in aquifers. I would have preferred an update of this chapter also, as it does not now very well reflect the considerable amount of more recent work on noble gases in lakes and the oceans.

This book is written in a remarkably clear and elegant language, which makes reading it a true pleasure. In particular, the terminology used among noble gas geochemists is well explained and sometimes also critically commented upon. Workers outside the field will probably find this particularly enlightening, but insiders will also profit. Unfortunately, some sections do not conform to this generally high standard and would have deserved a more thorough proofreading. Sometimes, I also missed references to recent crucial papers. For example, only the He isotopic composition in Jupiter's atmosphere is listed, although the Galileo probe also provided important data on Ne, Ar, and Xe. Overall, however, this new book will continue to be what the first edition has been for two decades: a primary reference that no worker in the field will want to miss on his shelf. No doubt this book will also help noble gas geochemistry to lose part of its reputation among non-practitioners as being largely incomprehensible. Hence, I also recommend it to all those who feel that noble gas geochemistry has—as the authors put it—"much the air of the secret society and its dark art."

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