

To boldly go

Grenville Turner

Lunar Sourcebook: A User's Guide to the Moon. Edited by Grant H. Heiken, David T. Vaniman and Bevan M. French. Cambridge University Press: 1991. Pp. 736. £50.00, \$59.50 (hbk).

REVIEWING a dictionary or an encyclopaedia is a difficult task, and so too with this book, which sets out to provide "a single, complete, and annotated description of our present knowledge of the Moon". If this book were a dictionary, however, one would have to point out that an important letter of the lunar alphabet, 'I' for isotope, is missing, but more of that anon.

The book is written by 25 contributors who have been immersed in lunar science for almost as many years. Three of the authors have acted as editors. The contents are a mixture of factual data summarized and systematized in tables, figures and text with relatively uncontroversial interpretation. The book is aimed at anyone, from scientist to space engineer, who wants to find out the current limits of our knowledge of the Moon. A short first chapter provides the reader with an introduction and a guide to using the book. The history of modern lunar exploration, culminating in the Apollo missions, is covered in the second chapter, which also introduces some of the main concepts of lunar science, from the giant impact theory of the Moon's origin to the early magma ocean and lunar differentiation. The reader is also introduced to the main lunar rock types and to the arcane details of lunar sample curation.

Chapter 3, ostensibly concerned with the external environment of the Moon, its transient atmosphere, meteorite bombardment and ionizing radiation, manages somewhat strangely to combine these topics with lunar heat flow, seismology and some aspects of lunar geology. For the geologist the meat of the book is in chapters 4 to 8, which deal with surface geological processes (impacts, volcanism and tectonics), lunar minerals, lunar rocks, the regolith and lunar chemistry, respectively. These are substantive and scholarly reviews and will form an ideal starting place for researchers or postgraduate students. Physical properties of the lunar regolith, particle sizes, density, compressibility and electromagnetic properties are covered in exhausting detail in chapter 9. Chapter 10 discusses geophysical and chemical data from orbital measurements, linking it to the regional geology and the geology of the Apollo landing sites. Twenty years after the last Apollo

landing, the concluding chapter makes a brave attempt to look forward to the future of lunar science, with a list of unanswered questions, future goals and schemes for permanent lunar bases.

The coverage of most areas of lunar science is so detailed and complete that it is really astonishing to have to comment on a really major omission, the absence of a serious attempt to discuss the vast array of isotopic data obtained from lunar samples. In the many and varied tables of data in the book, I found only one listing isotopic data. Also, apart from three or four figures summarizing schematically the conclusions of measurements on cores from the lunar regolith, I could not find any figures containing such data. The deficiencies are especially apparent in the superficial treatment of lunar age determinations throughout the book. Summaries of age measurements are largely confined to the chapter on lunar rocks, where 'ages' of highland rocks are tabulated according to breccia type. Because the petrological features relate mainly to local details of the impact, it makes little sense to discuss global lunar chronology in this context. Furthermore, the ages tabulated in chapter 6 do not even seem to be representative, there being no ages listed older than 3.95×10^9 years. Sm-Nd dating and the techniques of 'neutron stratigraphy', from which it was developed, are barely mentioned. Most serious of all, the fact that radiometric clocks carry important petrogenetic information on the relationship between chemistry and 'initial isotopic ratios' is completely overlooked. The reason for these and other omissions is clear from the list of authors, which does not include an easily identifiable expert in the field of isotope geochemistry.

For me the treatment of isotopes is a large disappointment, accentuated by the fact that in most other areas the book is first-rate. Writing the book clearly required a considerable effort by the authors and editors and it may be too much to hope that some future edition will remedy its one glaring deficiency. In spite of this, it is probably the best 'lunar dictionary' so far and an essential purchase for anyone with a serious interest in the Moon. □

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■ Elsevier have just published *Evolution of the Earth and Other Planetary Bodies* edited by R. Teisseyre, J. Leliwa-Kopystynski and B. Lang. This fifth volume in the series 'Physics and Evolution of the Earth's Interior' aims to provide cosmological insight into the formation and early evolution of the planetary system and the Earth. Dfl.370, \$211.50.

The calling of chaos

Robert M. May

Chance and Chaos. By David Ruelle. Princeton University Press: 1992. Pp.195. \$24.95, £19.95.

Searching for Certainty: What Science Can Know About the Future. By John L. Casti. Morrow/Scribners: 1992. Pp.496. \$12 (pbk), £16.99 (hbk).

WITH chaos and fractals featuring in a recent episode of the television detective series "Inspector Morse", it is clear that these topics are attracting wider attention. In London, one can visit a shop called Strange Attractions, which not only sells books, posters and T-shirts but also has a "chaos clinic" on Saturday mornings. (*The Sunday Times* said that the shop "will seduce a whole bizarre cross-section of people", while the *Evening Standard* said "it's weird but it's going to be big, very big".) The books reviewed here are two new entries in the chaos stakes.

David Ruelle, of the Institut des Hautes Etudes Scientifiques, just outside Paris, is one of the founders of the discipline. His book is a good translation of one that originally sold well in French. It is essentially a collection of some 26 short, connected essays (totaling 166 pages), along with a further 29 pages of much more detailed notes and comments set in smaller type. The book is aimed at the educated general reader and is largely free from jargon and equations (although some of the later chapters — for example those on quantum mechanics, equilibrium statistical mechanics and algorithmic complexity — do contain equations and, not only for this reason, are much more difficult than most of the earlier chapters).

Chance is the book's unifying theme. Beginning with conventional ideas about chance and probability, Ruelle leads us through the "deterministic randomness" of chaos (and its implications in physics, biology and economics), the assumptions about averaging that underlie statistical mechanics, the indeterminacy of quantum mechanics, and thence on to such things as Gödel's theorem of paradoxical undecidability in mathematical contexts and the role of unpredictability in the evolution of sex.

The book is an excellent read, either at one gulp or as chapter-by-chapter snacks. All the ideas are presented crisply and clearly, and even if one is thoroughly familiar with the material, one will enjoy the shameless digressions and the sardonic humour. One example (from the closing chapter): "what is the