access to a vast historical literature hitherto little known to Western historians of science; and to convince us that the Scientific Tradition is not the perquisite of the West.

Needham is among the last of the polymaths. Witty, confident, and masterful, entertaining, idiosyncratic, but above all broadly informed, he majestically guides us through a great metropolis of knowledge, from the Greek and Roman classics to the medical tracts of Moorish Spain, to Vedic sources, and through the early discoveries of late Medieval Europe. We are borne along by his enthusiasm for the subject and by his affection for the Chinese and their civilization.

The present volume is the first part of the section of the series dealing with botany. (The section is to be completed later by Georges Métaillé.) The volume starts with a summary exposition of the vegetation, climate, and soils of China, which is followed by a section that recounts the ancient development of floristic and ecological plant geography in China and another that extols Chinese botanical terminology and nomenclature. The main theme is then embarked upon, which is a commentary on the Chinese historical botanical references and monographs from their origins in and before the fourth pre-Christian century. The account of how the Chinese grasped, and described in a manner that can still be appreciated, the relationship between soils and the landscape on a local as well as regional basis helps explain how they evolved intensive yet sustainable forms of land-use that have survived for more than 2000 years. Needham's accounts of monographs on useful and ornamental plants, including citrus fruits, bamboos, and chrysanthemums, and the last section, in which he reviews the very early Chinese knowledge of natural pesticides and biological control, document the astonishing diversity of uses to which the Chinese have put their flora. During the European Dark Ages agricultural and horticultural techniques were burgeoning in China. Inevitably, nomenclatural defects are frequent in the text, and the author's limited knowledge of the natural history of the plants he mentions shows through at times; but nowhere does this detract from the usefulness of the work or limit it as means of access to Chinese sources.

Needham's work may at present be regarded as arcane, but I am confident that as the eastern nations reestablish their ascendancy in the civilized world, so his gargantuan enterprise will prove fundamental to our understanding of their success. Needham is a worthy successor to Li Shih-Chen, "prince of pharmacists," whose 16th-century Great Pharmacopoeia, described by Needham as "a pandectal treatise on mineralogy, metallurgy, mycology, botany, zoology, physiology and other sciences," is only now surpassed.

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Kimberlite Geology

Kimberlites. Mineralogy, Geochemistry, and Petrology. ROGER H. MITCHELL. Plenum, New York, 1986. xviii, 442 pp., illus. $65.

Before about 1970, the study of kimberlites and their included diamonds and ultramafic xenoliths was pursued by only a few investigators. Interest in these topics has since mushroomed, as has the number of kimberlite-related publications. The nonspecialist now needs a guide to get started in the kimberlite world. Roger Mitchell has undertaken the task of writing such a guide and in this book has provided a comprehensive review of virtually all aspects of kimberlite geology, including morphology, emplacement, mineralogy, mineral and whole rock chemistry, tectonic setting, and petrogenesis. The book deals only with kimberlites and does not cover accidental inclusions, notably mantle nodules and diamonds, as did Barry Dawson's *Kimberlites and Their Xenoliths* (1980). Because Mitchell provides a more thorough and updated treatment of kimberlites, his volume may replace most of the kimberlite section of Dawson's book.

The book is well written and amply illustrated with line drawings in the sections on kimberlite morphology, distribution, occurrence, and tectonic setting. Outcrop photos of kimberlite features would have been a welcome addition, despite the fact that many kimberlite exposures are unimpressive. In the mineralogy and geochemistry portions Mitchell provides many data tables, representing analyses from well-documented, typical, or unusual occurrences. Included in these sections are numerous useful plots of chemical data illustrating the chemical trends or other features described in the text. Unfortunately, some of the photomicrographs of kimberlite textures are of poor quality.

In the preface Mitchell states, "This book is intended to be informative to the neophyte while being of lasting value to the specialist." He accomplishes both of these objectives, for even kimberlite researchers can turn to this book to learn about topics outside their immediate specialty. There are, however, a number of small flaws in the book that will be apparent to those familiar with the details of specific topics. Aside from typographical errors and obvious misstatements, such as referring to the two strike directions of kimberlite dikes in Lesotho as WNW and ESE, there are misinterpretations or misquotations of some works. Given the extensive list of references (34 pages) that Mitchell had to read and assimilate, such errors are understandable and should not matter to most readers.

Mitchell presents his characteristically conservative approach to kimberlite classification, even to the point of suggesting that some of the well-known micaceous kimberlites (for example, Roberts Victor, Bellsbank) might be better classified as a distinct rock type, namely, "orangite." This does not detract substantially from the value of the book but should indicate to the reader that interpretations and viewpoints in other portions of the book may be equally conservative and not generally accepted. In addition, the treatment of conclusions is uneven. Where Mitchell feels strongly about a given topic (for example, the definition of "kimberlite"), the conclusions are strongly stated. Where he is less personally involved (for example, on the tectonic setting of kimberlites), the conclusions are weak or nonexistent.

Generally, though, Mitchell attempts to synthesize the available observations and reconcile conflicting models. For example, after the description of diatreme structures and the opposing fluidization and hydrovolcanic models for their origin, he presents Clement's model incorporating both mechanisms and introduces his own modifications; the result is an explanation that he believes fits most of the available data.

Overall, this is an excellent book. Researchers working in kimberlites should find it a useful reference, and it will serve as a good introduction to the field for those just starting out.

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Planetary Evolution

Atmospheres and Ionospheres of the Outer Planets and Their Satellites. SUSHIL K. ATREYA. Springer-Verlag, New York, 1986. xiv, 224 pp., illus. $69.50. Physics and Chemistry in Space, vol. 15.

This book summarizes current knowledge of the atmospheres and ionospheres of the outer planets. Although the visits of Pioneer

and Voyager have greatly increased our understanding of the outer solar system, there are many questions still unanswered and a host of scientists independently searching for answers.

The book is best described as a topical review. The breadth of the topic has forced the author to limit associated reference citations to the areas of planetary photochemistry and, to a lesser extent, atmospheric thermodynamics. The sections on the photochemistry of Jupiter, Io, and Titan are particularly interesting and fairly complete. Radiative transfer and occultation measurement techniques are also discussed. Less satisfying and complete are the treatment of particle impact processes and discussions of the energetics of the thermospheres of the outer planets. One particular shortcoming is the lack of discussion of the Voyager infrared data analysis in the context of outer planet cloud physics.

The material in the book is reasonably up to date and includes preliminary results of the recent Voyager-Uranus encounter. The book contains some personal conjectures, for instance in the discussions of electroglow, the Saturn thermal structure, and the upper atmospheric heating at Jupiter from charged particle impact, without sufficient caveat to the reader who is new to the field. This detracts little from the strength of the book, which is in its excellent review of photochemical processes at the outer planets. The book serves as a readable introduction to this area of research for both trained atmospheric scientists and graduate students. It is not particularly useful as a graduate textbook, however, because of its rather terse treatment of the basic chemistry and physics of planetary atmospheres. It provides a fascinating look at the chemical systems of the outer planets with an eye to where it all began. Anyone interested in the evolution of our solar system will want to read it.

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