REVIEW

Geology of the Moon: a stratigraphic view; by THOMAS A. MUTCH. P. xiv, 324, num. figs. Princeton, N.J., 1970 (Princeton Univ. Press, $17.50).—This volume is primarily a synthesis of the geological studies that preceded the Apollo 11 mission to the moon with emphasis placed largely on the work of the Center of Astrogeology, U.S. Geological Survey. Since both the Survey reports and most NASA documents concerning the subject are not widely available, the book should be of value to all those who deal with lunar science. It is well written and profusely illustrated. The author's philosophical attitudes and captivating style make arduous discussions pleasant reading.

The book is divided into 12 chapters, starting with a historical review and background information, building up to a discussion of detailed lunar stratigraphy, and ending with a chapter on the Apollo 11 mission results. Discussions of the history of the development of lunar science fall short of the specialist's demands. This, however, is compensated for by the fact that chapters dealing with lunar stratigraphy and its historical development far exceed the expectations.

A well known stratigrapher, Professor Mutch is very successful in presenting the stages of development of the young science of lunar stratigraphy. He is aware of the constraints under which the pioneers of the science in the early 60's worked. He is also aware of the limitations of applicable theories and principles. Because of this awareness he has provided us with a well-balanced treatment of the subject; a most needed starting point for detailed work on the wealth of data that will be accumulated as the moon is further explored, on the surface and from orbit, in the next few years.

Much of the moon's surface was geologically mapped by the use of the telescope. The effort was based on the premise set forth in 1962 by Shoemaker and Hackman that "the geological law of superposition is as valid on the moon as it is on earth." Concentrating attention on the area around the crater Copernicus, they pictured the lunar surface as built up of a complex of ejecta layers, material underlying the crater walls and floors, and material that occupies the maria. Hence a stratigraphic column of material units and corresponding time-stratigraphic units was constructed, and its moon-wide application was illustrated by a number of mappers. Mutch follows these developments closely and shows how a relative chronology of lunar materials was constructed. He also shows how the lunar mappers have produced evidence, at times compelling, that both impact and volcanism played a role in shaping and modifying the lunar surface. Much of this evidence is encapsuled in the wealth of photographic data obtained by Ranger, Surveyor, and especially Lunar Orbiter.

The author, however, did not show the impact of recently acquired geophysical knowledge on our understanding of the moon, the potential use of the grid system of lineaments in deciphering the highland stratigraphy (although structural control is discussed in the case of Hommel Quadrangle), and the applicability of the results of specialized remote

sensing techniques to lunar geology. In relation to the latter the author concludes that "The entire field of 'remote sensing' emerges as one in which instrumental elegance has far outstripped understanding of physical behavior. The potential remains exciting but unrealized" (p. 58). There are exceptions to this. Radar anomalies at 3.8 cm and 70 cm correlate with distinct properties of lunar surface materials, that is, hummocky or blocky ejecta zones around relatively young craters. These anomalies also correlate with eclipse thermal anomalies detected by IR sensing of the lunar surface. Other remote sensing techniques, for example multispectral sensing, appear to be standing the test in predicting compositional differences or similarities of lunar surface materials. The value of these techniques should be realized to utilize fully our means of understanding the moon, its history, and relationship to Earth.

In the Preface to the book, the author states that "It was clear from the very start that the value of this book would rest in large part on the illustrations." Although the photographs and drawings are well selected, some photographs are not fully described; in some cases the photographs depict named features which are not referred to either in the captions or in the text, for example, figures VIII-13, 14, and 15 show Rimae Parry, Hippalus, and Prinz respectively and are not identified correspondingly in the captions. Two other volumes would complement this one in illustrations: one in the quality of reproductions (*Lunar Panorama: A Photographic Guide to the Geology of the Moon*; by Paul D. Lowman, Jr., Weltflugbild, Zurich, Switzerland, 1969) and the other in the completeness of feature portrayal (*The Moon as Viewed by Lunar Orbiter*; by L. J. Kosofsky and Farouk El-Baz, U.S. Government Printing Office, Washington, D.C., 1970).

A final word of criticism concerns the last 2 chapters. Chapter XI "Lunar Stratigraphy Reconsidered" (4 pages) is written in an abstract form and does not make its intended point very clear. The last chapter dealing with the "Apollo XI Results" (18 pages) does not show how our knowledge from Apollo lunar exploration will affect our understanding of the moon and adds very little to the value of the book. It must be realized, however, that the last chapter was appended to the book soon after the first preliminary results were available. A chapter dealing with a concise summary of lunar stratigraphy and a glossary of terms would, in my viewpoint, have been proper replacements of these two chapters.

Finally, Mutch's book is a welcome addition to the few volumes on lunar science. It is an excellent introduction to the geology of the moon and provides the best available text on lunar stratigraphy for undergraduate or graduate courses. The author is very successful in portraying analogs familiar to the student of geology of the lunar surface features and processes. It will perhaps be most useful to professional geologists who wish to acquaint themselves with recent advances in lunar geology. To lunar scientists with little or no background in geology, this volume is a must.

FAROUK EL-BAZ