Book Reviews

Planetary Science

Saturn. TOM GEHRELS and MILDRED SHAPLEY MATTHEWS, Eds. University of Arizona Press, Tucson, 1984. xii, 968 pp., illus. $37.50. Space Science Series.

Ever since the first telescopic observations of Saturn in 1610, Saturn has intrigued and mystified astronomers. In that year, Galileo turned his newly constructed telescope to Saturn and saw to his "great amazement not a single star, but three together" (quoted on p. 24 of *Saturn*). Galileo had discovered the rings of Saturn, without recognizing them as such. Some 370 years later, laypeople and scientists alike were amazed when the Voyager spacecraft revealed the magnificent complexity of the ring system and its thousands of ringlets. The Pioneer and Voyager encounters have vastly increased our understanding of Saturn, but the mysteries of the planet have, if anything, increased in proportion.

The wonders of the Saturn system span the full range of planetary science. The ring system, with its gaps, ringlets, waves, and numerous small satellites, has revealed an unexpected richness of phenomena arising from the most familiar of interactions, Newtonian gravity. The ratio of helium to hydrogen in Saturn's atmosphere is notably less than that in the atmospheres of Jupiter or the sun, and it may be that helium is raining down into Saturn's interior. This may explain how Saturn emits almost twice as much energy as it receives from the sun. Saturn's true interior rotation rate was determined for the first time by Voyager observations of periodic radio emissions, similar to those emitted by Earth, Jupiter, and maybe even pulsars. However, Saturn's pulsar action is a mystery because its magnetic field is almost perfectly symmetric about its rotation axis. Saturn's magnetosphere has vast clouds of neutral atoms and molecules and a dense, heavy ion torus, both reminiscent of Jupiter. However, Saturn's aurora is Earth-like, not Jovian. Saturn's moon Titan has an atmosphere, composed mainly of nitrogen, that is denser than Earth's, and methane at Titan is being converted irreversibly to hydrocarbons such as ethane. There may be hydrocarbon lakes or oceans on Titan's surface, but the surface is completely obscured from view by a dense atmospheric aerosol.

The above is admittedly an arbitrary selection among Saturn's many delights, but it may serve to indicate the scope of modern Saturn science. The scope of the book *Saturn* is no less: the preface states, "This book is to summarize it all." To this end, 78 authors contributed 21 chapters on topics including Saturn's interior, atmosphere, ionosphere, and magnetosphere; Saturn's rings; Saturn's moons and their interiors, surfaces, and orbits; Titan's interior, atmosphere, and magnetosphere; and the origin and evolution of the Saturn system. Ambitious indeed, yet the book is largely successful.

Though I expect that any reader will find that only a small portion of the book deals with topics within or related to his or her particular specialty, I am happy to report that the book is written at a level suitable for graduate students and nonspecialists. I am a magnetospheric physicist, and nine of 21 chapters deal with magnetospheres in whole or in part. The book is therefore largely outside my field, but I found it generally interesting and stimulating reading nonetheless. On the whole, the discussions are clear and emphasize the physics without excessive detail. An overview chapter by Stone and Owen is particularly useful.

The chapters on magnetospheric physics are of uneven quality. Among the more successful of the magnetosphere chapters are those by Kaiser *et al.* dealing with radio emission and by Schardt *et al.* on the outer magnetosphere. Each of these provides a useful overview and synthesis of the data, with comparisons of the results obtained by the various spacecraft and a summary of theoretical ideas. Two chapters on Titan's atmosphere and magnetosphere, by Hunten *et al.* and Neubauer *et al.*, are also excellent. On the other hand, chapters by Van Allen and Scarf *et al.* duplicate many of the data presented by Schardt *et al.* without providing much synthesis or overview. Van Allen does briefly discuss radial diffusion, and Scarf *et al.* do present data on plasma waves.

Some obvious errors are present. In figure 4 on p. 652 the F-ring shepherds are called Janus and Epimetheus; table II on p. 423 lists a bow shock crossing at 4.1 R_S. The frequency of errors, however, does not appear excessive.

On the whole, *Saturn* is an excellent book and a worthy companion to the 1976 book *Jupiter*, also edited by Gehrels, which was a classic in its time and remains a useful reference today. *Saturn* is at the moment without peer. Nowhere else in the literature is there as comprehensive, up-to-date, and accurate a summary of Saturn science. The book is an essential acquisition for libraries and is recommended to planetary scientists in general.

ANDREW F. CHENG
Applied Physics Laboratory,
Johns Hopkins University,
Laurel, Maryland 20707

Microbiology

The Microbe 1984. Cambridge University Press, New York, 1984. In two volumes. Part 1, Viruses. B. W. J. MAHY and J. R. PATTISON, Eds. x, 344 pp., illus. $59.50. Part 2, Prokaryotes and Eukaryotes. D. P. KELLY and N. G. CARR, Eds. x, 349 pp., illus. $59.50. Symposia of the Society for General Microbiology, 36. From a symposium, Warwick, U.K., April 1984.

In honor of their 100th meeting, the Society of General Microbiology went after the whole thing. Instead of following their custom of publishing the proceedings of a yearly symposium on the status of a particular field of microbiology, they invited eminent microbiologists to review the present state of knowledge in microbiology and to look at what the future might hold. The result is two informative and provocative volumes, the first on the viruses, the second on the bacteria (the subtitle includes the eukaryotes, but these have scant mention).

The first volume opens with a history of virology by Wildy. Although itself an example of epivirology, that "somewhat despised handmaiden," embracing viral taxonomy, history of virology, and the like, the paper presents an engaging personal view of the subject and its fragmentation into subdisciplines. The wide range of virological investigation, extending from epidemiology to molecular biology, is well represented in this rea-