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.

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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-

sonably brief and digestible volume. The topics presented range from the global to the molecular and are in general those on which research is the most active. At the high end of biological complexity are descriptions of new virus diseases by Pattison *et al.* and a discussion of prospects for eradication of viruses by Tyrrell. To our surprise, measles and polio are judged the best candidates to follow smallpox into oblivion, although perhaps not very soon. Proceeding to the less complex there are a comprehensive, up-to-date, and readable account of the newly appreciated role of many different viruses in human cancer by Weiss and a general discussion of important aspects of the interaction of viruses with their animal hosts by Fields. A treatise on retroviral carcinogenesis by Bishop is accurate and readable despite an occasional tendency to endow viruses with human characteristics, as in "a retrovirus intent upon the seizure of a cellular gene." At the greatest level of resolution are detailed discussions of the structure and replication of viroids, plant pathogens devastating despite their small size, by Sanger, of the initiation of poliovirus replication by Baltimore, and of the importance of recombinational events to the lifestyle of bacteriophages, particularly μ, by Symonds. Finally, there are papers on the structure of viruses, by Harrison, the nature of viral genetic material, by McGeoch, and the molecular evolution of viruses, by Reanney. The paper by Harrison contains a particularly clear analysis of a difficult subject and could easily be used to introduce students to the way one should think about virion structure.

The volume on the bacteria is even broader in scope. Most of the papers in it deal with environmental and evolutionary aspects of the microbial world. The first paper, by Schlegel, is entitled "Global impact of prokaryotes and eukaryotes." It is followed by "Microbial behaviour in natural environments" by Pfennig, which illustrates with exciting examples how much is known about this topic. A more detailed example, Jannasch's presentation of the amazing world of life at the deep-sea thermal vents, should convert the most hardened reductionist. Harder *et al.* review environmental regulation of metabolism and Thauer and Morris update our knowledge of the chemotropic anaerobes. Shapiro proposes that molecular genetics may permit the study of cellular differentiation via colony morphology. The only totally specific paper, by Reznikoff, is on the promoter of the lactose operon. The impact of the microbe in medicine is discussed by Arbuthnott, but only from the point of view of prevention and treatment. Newly recognized microbes from varied environments are described by S. T. Williams *et al.* The production of new strains that result from genetic engineering is discussed by Hopwood and Johnston. The book terminates with an appropriately futuristic essay by Postgate, who reminds us that the microbial world—and those who study it—will be involved in both disasters and utopian developments. Orwell would have approved.

These volumes represent a celebration of an essential aspect of life on this globe and the jubilation that comes from our knowledge of it.

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A Naturalist of Means

Dear Lord Rothschild. Birds, Butterflies and History. MIRIAM ROTHSCHILD. Balaban, Philadelphia, and Hutchinson, London, 1984 (U.S. distributor, ISI Press, Philadelphia. xxiv, 398 pp. + plates. $29.95.

The Balfour Declaration of 1917, promising British support for "the establishment in Palestine of a national home for the Jewish people," was not proclaimed as a public document but as a personal letter to "Dear Lord Rothschild," titular chief of the great banking family and de facto head of Britain's Jewish community. But Walter Rothschild found banking distasteful and felt indifferent to politics (though he worked hard for the declaration); his true love lay elsewhere. When Chaim Weizmann, the Zionist leader, left for Palestine to see if he could facilitate the implementation of Balfour's declaration, Rothschild gave him another mission: "I want to find out what has become of two ostriches." Rothschild, world's greatest collector and dedicated professional taxonomist, had left the ostriches in care of a naturalist-schoolteacher near Jaffa and had lost contact with him during the disruptions of wartime. Weizmann dutifully located the ostriches, and Rothschild eventually described them as a new subspecies, *Struthio camelus syriacus*.

A passion for natural history is not rare; many of us (but not me) happily arise at an hour fit only for the closing of New York's bars, all to watch things that go tweet in the dawn. But combine this passion with unbounded energy, the devotion of a powerfully eccentric personality (who loved to drive his four-in-hand of zebras right down Picadilly), and (as bottom line) the wealth of the Rothschilds, and you have a force that can move mountains and greatly augment nomenclature. Walter Rothschild did both. His life was like the set of *Cats*, everything scaled way up, from his person (he weighed more than 300 pounds), to his resources, to his collections.

Walter Rothschild, specializing in birds and butterflies, built the largest collection in natural history ever assembled by one man. At times, he employed more than 400 collectors spread throughout the world. One cartographer, looking at a map with red dots marking Rothschild's sites of operation, said that it resembled "the world with a severe attack of measles." Rothschild built a museum at Tring (still well worth a visit) so stuffed with specimens that the zebras kneel or lie down so that one or two more rows may be inserted in the floor-to-ceiling display.

But Walter Rothschild was not a mere gatherer or mindless collector interested only in augmenting his life list. He established two of the world's finest taxonomists as curators at Tring, E. Hartert and K. Jordan (quite an act of ecumenicism, especially amid the jingoism of World War I, and for an English Jew, since both were German). He founded a journal, *Novitates Zoologicae*, to print their taxonomic results, and then he, and Hartert and Jordan, published and published and published—more than 5000 new species in 1200 books and papers. Moreover, the Tring trio were not mere describers but thinkers and reformers as well. They pushed the trinomial system (adding a subspecific name to the Linnaean binomial to characterize geographic variation) when it represented a real reform and departure from the static, typological concept of species. They advocated the collection of large series, not just typical individuals, for defining species, thereby reinforcing again the cardinal evolutionary idea that variation is irreducible and the stuff of change.

Miriam Rothschild is the world's greatest taxonomist of the Siphonaptera (fleas to the uninitiated), and Walter's niece. She has written a partly fascinating, always enlightening, and thoroughly maddening book to celebrate her uncle's (larger than) life. It contains more than anyone but a dutiful relative could ever want to know about Walter and his family, all written from a perspective assuming that the whole world knows and grew