interpretation of cognitive illusions. Although he struggles to see the past in its own terms, he cannot resist reproaching early opponents of Darwin and of Copernicus for their cognitively explicable but rationally indefensible failure to embrace the new theories—Lyell's resistance to natural selection is "cognitively not much different from (not much more logical than)" resistance to wearing hockey helmets (p. 192), just as subjects in psychological experiments are "stubborn" and "downright stupid" in not applying modus tollens or Bayes's theorem.

In both cognitive psychology and the history of science, this normative *idée fixe* prevents Margolis from posing more interesting descriptive questions about how we cope with ambiguity and how the standards for explanation, not just this or that explanation, change in science. Although an abiding concern with rationality motivated Margolis's study, there seems to be nothing in his *P*-cognition view *per se* that would commit him to such a narrow normative stance. Margolis believes his account will prove itself by its empirical applications in fields like cognitive psychology and history of science. We believe, on the contrary, that the results of these initial empirical applications are largely disappointing, but that the general Darwinian outlook of *P*-cognition so ably developed by Margolis will prove of enduring value.

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Microbial Ecology

Microbial Mats. Physiological Ecology of Benthic Microbial Communities. YEHUDA COHEN and EUGENE ROSENBERG, Eds. American Society for Microbiology, Washington, DC, 1989. xviii, 494 pp., illus. $79; to ASM members, $59. From a seminar, Eilat, Israel, Sept. 1987.

Layered microbial communities, and the complex and intense biogeochemical interactions that occur within them, constitute a type of community structure that is fast becoming an important paradigm for the understanding of microbial ecology. Such communities, within which are included microbial mats, often remain poorly appreciated or understood even by those in the field, however. For this reason alone, *Microbial Mats: Physiological Ecology of Benthic Microbial Communities* is highly recommended. This interesting and informative book presents the results of a 1987 symposium: its rather tardy publication is a pity, but much of the material contained in it is excellent and not at all outdated.

As expected, there is variation in style and quality among the papers, but the volume includes well-written contributions from many of the major laboratories involved in microbial mat research. In coverage it ranges from the basic physiology of mat organisms, to isotopic and molecular genetic methods for the study of mat populations, to chemical and paleomicrobiological methods of looking at present and past mat communities.

The book includes excellent descriptions of a variety of different mat environments (hot springs, hydrothermal vents, and hypersaline ponds and lakes). There are discussions of the structure, function, and chemistry of these environments, including redox chemistry, oxygen gradients, carbon cycling, and light penetration and quality, along with presentations of techniques used to study these features. These include discussions of microelectrodes and new chemical approaches and an intriguing chapter on the use of fiber optic light guides for the measurement of spectral quality in mat communities, by B. B. Jorgensen. There is an entire section devoted to the physiology and biochemistry of some of the major mat-building organisms and techniques used to study them and another to their evolution and phylogeny, including an informative discussion of methods of molecular phylogeny by Turner *et al.* The final section deals with chemical and paleobiological studies of modern and ancient mats, concluding with an excellent chapter by Andrew Knoll discussing the paleomicrobiology of ancient mat communities. Knoll's concluding statement, "Limits to the interpretation of Proterozoic sedimentary successions . . . will not be reached until we know more about the present," provides a strong rationale for the study of the modern mat communities discussed elsewhere in the book. In fact, reading this chapter first might well provide the reader with a valuable perspective for many of the other studies reported here.

In this regard the lack in the book of an overview of the subject is troublesome. Apart from a preface by Cohen little or no effort is made to introduce either non-experts or students, who might potentially use this book, to the broader picture of the types of mats, the factors that define them, variations found in extant mats, and the short-term and long-term significance of mat communities. For example, comparison of mat communities with other layered microbial communities, such as those found in fjords, marine and freshwater sediments, and stratified lakes would have been welcome. The book will, even so, be a valuable addition to the libraries of microbial ecologists and others interested in organismal interactions, the evolution of microbial communities, and biogeochemistry. It should be a valuable teaching aid at the graduate level and will provide thought-provoking and informative material for years to come.

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Topics in Astrophysics

Astrophysics of Gaseous Nebulae and Active Galactic Nuclei. DONALD E. OSTERBROCK. University Science Books, Mill Valley, CA, 1988. xviii, 408 pp., illus. $36.

In 1864 William Huggins aimed his spectroscope at nebulae and discovered that some showed emission lines (hence "gaseous nebulae"), whereas others showed star-like spectra. In 1974, when appeared Osterbrock's now classic textbook on the optical spectroscopy of photoionized gas, *Astrophysics of Gaseous Nebulae,* its subject still dominated the fields implied by the title. Like many of my contemporaries, I learned the physics of photoionized gas from the 1974 book. My opinions on this revised version thus reflect gratitude to a reference tattered by a decade of use, compromised by an undergraduate's desire for revenge on an opaque textbook.

As an introduction to the physics of photoionization, line transfer, and optical diagnosis of diffuse atomic gas, it remains without peers. The first nine chapters are largely unchanged. The discussion of charge-exchange reactions has been updated, and it is now publicly confessed that HII regions may not be homogeneous, spherical, or similar to the sun in abundances of elements. References to the recent literature are given, and the tables incorporate modern data. An infuriating number of misprints infested the first edition; many but by no means all of these have been corrected. Three new chapters have been added. One describes the optical line emission from nova and supernova shells, and two briefly review diagnostics and classification of the emission-line regions of active galactic nuclei. The reader is introduced to Seyferts 1.8 and 1.9 but is spared further significant figures.

The subject matter is fundamental to all of astrophysics, and being without serious competition this book will appear on the desks of astronomers at all stages of their