Reproduction, Ecology, Physiology and Biochemistry, and Seaweeds as Resources. The sections each have brief introductions that, for the most part, provide valuable perspectives for the detailed chapters to follow. However, it must be admitted that the simplistic generalizations in the introductions to the sections on ecology and on physiology and biochemistry are not in keeping with the scholarly treatments that follow.

Almost 300 pages are devoted to structure and reproduction, with life histories separated from morphology and classification and the three taxonomic divisions (Chlorophyta, Phaeophyta, and Rhodophyta) treated separately. These chapters are not for the uninformed. They will be of interest to those who are familiar with the basic features of algal structure, life histories, and classification and who want to learn of the many doubts and controversies surrounding many of the generally accepted views. As with many books on algae, the level of detail and specialization involved in discussions of structure, reproduction, and classification is not paralleled in the considerations of such topics as ecology and physiology.

In *The Ecology of Algae*, Round has attempted a monumental task. In addition to addressing the complete range of habitats within which algae occur, he attempts integrated presentations of topics such as symbiosis, parasitism, and grazing (one chapter), annual succession and growth, energy flow and nutrient cycling, and paleoecology. Also, he aims "to lead the reader into the relevant literature by illustrating points with *quoted* examples [his italics] rather than generalized statements." Certainly the book abounds with detailed presentations of data (almost 40 percent of the pages are filled with figures and tables), and more than 2100 references are included. Although the author claims that emphasis is placed on recent literature, the relativity of the word "recent" is obvious, as in references to "a recent analysis (Stull, 1975)" and "the recent international study of the Indian Ocean . . . during the 1960's," and no paper later than 1978 is mentioned.

I wish I could say that the author's monumental task had been successfully accomplished. Round has certainly shown the extreme range of habitats within which algae may be found. Also he has provided many examples with which many readers may be unfamiliar. But the fascination of algae in nature and the intellectual excitement of studying them are buried beneath the mass of detail and obscured by the approach. For example, the attempts to classify and name habitats and communities—examples being "epipsammon," "endolithon," "epipelon," "pseudoplankton (=tychoplankton)"—appear contrived and pedantic. The strict correctness of the terms is not in question, but the emphasis given to them impedes rather than enhances our understanding of algae in nature. Similarly, the selection of data for detailed presentation appears more idiosyncratic than interesting. Finally, the length of treatment and the attempt at comprehensiveness ensure that the reader is not left with a clear view of present-day studies of algal ecology or with an awareness of the problems and concepts that are currently exciting scientists concerned with the relationships between algae and their environment. Round has written a lengthy statement of his own perspective that gives an unfortunate impression of self-indulgence. Pascal once apologized to a friend, "I have made this letter longer than usual because I lack the time to make it short." It is a sentiment of some relevance to this book.

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A Theory of Vision

Vision. A Computational Investigation into the Human Representation and Processing of Visual Information. DAVID MARR. Freeman, San Francisco, 1982. xviii, 398 pp., illus. $29.95.

When David Marr died last year at the age of 35, he had already become a legend among neuroscientists. His posthumous book, *Vision*, is a synopsis of the work that made his reputation—his computational theories of the human visual system.

When Marr visited the Artificial Intelligence Laboratory at MIT in 1973, it was already being suggested that experimental psychology might have much to gain from computational theories, but the idea of a computational theory was still foreign to neurophysiology (apart from one or two flashes of insight by Horace Barlow). Marr describes how the considerable momentum generated by the work of Hubel and Wiesel seemed to be decaying without having led to any clear idea of the processes that are involved in actually seeing things. Marr realized, and insisted, that any information processing theory of vision must be addressed to questions at several different levels of abstraction. Just as in computing systems one must distinguish between the logic of a program and the circuitry of the computer on which the program is running, so in human vision one must distinguish between the neurophysiology of the visual system and more abstract entities such as the Fourier spectrum of a retinal image or the disparities between corresponding points in two such images. But Marr insisted on the need to take a global view of visual information processing. What precisely was the task being executed by the system? On what properties of the world could a system performing this task be expected to rely? What general method or methods could be shown to be effective in the performance of the task? Given a particular method, what algorithm or algorithms could be devised for its implementation? Given a particular algorithm, what sort of neural circuitry would be required, or would suffice, to carry it out? Do any of the known components of the visual system answer to these specifications?

Marr's particular achievement was to force such questions on the attention of neuroscientists. If neurophysiology was a theoretical vacuum when he entered it, it is now seething with lively controversy about the validity of his ideas on the visual system.

Vision has seven chapters. The first begins with a historical survey and then outlines Marr's own philosophy and approach to the study of vision. There are sections on the understanding of complex information processing systems and on the necessity of adopting an appropriate representational framework. Chapter 2 is devoted to the way in which images are represented. In it Marr reviews his already well-known concept of the "primal sketch" and the steps by which it may be built up from elementary features of the image. He examines the nature of the processes that lead to the grouping of elements and distinguishes between the "raw" primal sketch and the "full" primal sketch in which groups of features are labeled as belonging together. Chapter 3 describes the processes whereby visual images are interpreted as arising from surfaces, and particular attention is paid to the clues that are supplied by apparent motion and by stereoscopic disparities. In the following chapter we meet the "$2\frac{1}{2}$-D sketch," in which the visual information is represented as arising from surfaces of specified slope and tilt relative to the line of sight. Chapter 5, on shape recognition, passes to the final

form of representation, namely the full 3-D model, and proposes types of description that can be compared directly with the forms of familiar or indeed unfamiliar objects. Chapter 6 draws all these threads together and closes the main part of the book, but there is a delightful epilogue (chapter 7), which takes the form of a conversation between Marr and an intelligent critic of his ideas (could this be Francis Crick?) and touches on a number of more general issues about the nature of psychological theories. This chapter should be compulsory reading for all psychology students whether or not they are interested in visual perception.

Vision will be seen as a milestone in the history of the subject. Even if no single one of Marr's detailed hypotheses ultimately survives, which is unlikely, the questions he raises can no longer be ignored and the methodology he proposes seems to be the only one that has any hope of illuminating the bewildering circuitry of the central nervous system. David Marr's lifework will have been vindicated when neuroscientists cannot understand how it was ever possible to doubt the validity of his theoretical maxims.

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Stellar Explosions

Supernovae. A Survey of Current Research. Proceedings of an institute, Cambridge, England, June 1981. MARTIN J. REES and RAY J. STONEHAM, Eds. Reidel, Boston, 1982 (distributor, Kluwer Boston, Hingham, Mass.). xxiv, 590 pp., illus. $69. NATO Advanced Study Institutes Series C, vol. 90.

This volume of symposium proceedings, supplemented by the proceedings of IAU symposium No. 101 on supernova remnants, will provide an authoritative and up-to-date survey of this important and fast-developing field.

The first half of *Supernovae* contains a series of papers on theories of supernova formation that provide an almost embarrasing number of ways in which single stars of widely differing masses can explode to become supernovae. Additional mechanisms involve production of supernovae by mass transfer onto white dwarfs in binary systems. What is not yet clear is how the plethora of theoretical supernova models is to be related to the spectroscopic observations that show only two distinct types of supernovae: Type I, which do not show hydrogen absorption, and Type II, which do.

Observations in the Galaxy and the Magellanic clouds show that there are at least three quite distinct types of young supernova remnants, of which Cassiopeia A, the Crab Nebula, and the remnant of Tycho's supernova of 1572 are the prototypes. It is not at all clear yet how these three types of remnants are related to the two kinds of supernovae that are actually observed.

The excellent discussions in the volume of supernova frequency by Tammann and of the pulsar birthrate by Lyne reduce but do not yet eliminate the apparent discrepancy between these two quantities. (Since about a third of the most recent supernovae have left pulsars one would expect the supernova birthrate to be approximately three times higher than that of pulsars.) It is significant that such a discrepancy between supernova and pulsar rates remains even though Tammann has adopted supernova rates that may turn out to have been somewhat too optimistic. From his rates one calculates that a supernova should occur in M 31, M 33, the Large Magellanic Cloud, and the Small Magellanic Cloud once every 16.3 years, whereas only a single supernova has been seen in these galaxies during the last century.

Finally, a number of authors emphasize the importance of better statistical data on the supernova frequency in distant galaxies. The development of charge-coupled device detectors and of computer-controlled telescopes should enable us to obtain such improved data in the near future. Furthermore, such new observations should allow one to see if the usually overexposed cores of galaxies exhibit a much higher supernova frequency than has so far been suspected.

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