postulate a growth curve for *Euphausia superba*. The population dynamics of this animal that may someday feed the world is so poorly understood that we do not know if it lives two years or maybe four. Obvious difficulties await those who would apply conventional fishery calculations to estimate maximum sustainable yield. Mauchline, employing regressions he developed earlier to express growth rates of other crustaceans, estimates that the life cycle may be two, three, or four years, depending on environmental temperatures and feeding conditions. It's a nice bit of speculation.

In general, this book, paired with its 1969 counterpart, will be indispensable to those newly interested in the biology of euphausiids, and the smaller group engrossed in the biology of mysids will be pleased that their animals have at last received the attention of a review.

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The Solar-Stellar Connection

Solar Phenomena in Stars and Stellar Systems. Proceedings of an institute, Bonas, France, Aug. 1980. ROGER M. BONNET and ANDREA K. DUPREE, Eds. Reidel, Boston, 1981 (distributor, Kluwer Boston, Hingham, Mass.). x, 592 pp., illus. $69.50. NATO Advanced Study Institutes Series C, vol. 68.

Within the last decade solar physicists and stellar astronomers have rediscovered that the sun is a star. Early in this century, astronomers often used the sun as a benchmark against which to compare their crude stellar observations, but after they had reached the limits of their technology and exhausted the possibilities of comparison with the sun and its spectrum our star was relegated to an occasional appearance as a dot in a published color-magnitude diagram. Meanwhile, solar physicists busied themselves with studies of minute photospheric and chromospheric features and research into the appearance and nature of the solar cycle—matters that were clearly of no interest to those who did their observing after sunset.

All that has changed now. This thick volume is the proceedings of a meeting on the subject of the many connections that now exist between solar and stellar research. The papers are divided into three sections, on solar and stellar variability; chromospheres, coronas and convective phenomena; and solar and stellar interiors. It is clear that in all three of these areas the reason for the sudden burst of research activity is that there have been various improvements in the technological level of astronomical instrumentation in recent years.

The book begins with an overview by R. W. Noyes, which lays a solid foundation for all the contributions that follow. Solar and stellar interiors are treated in two review papers, one theoretical and the other observational. The observational paper, by E. Fossat, is a clear presentation of the fundamentals of solar and stellar oscillations and their detection. Already work on these oscillations is beginning to tell us something about the interior dynamics of the sun, and there is hope that before long, by means of seismic-type probing, we will be able to learn a great deal about the interior structure and dynamics of the sun and other stars. This is one of the most exciting developments in astronomy in many years.

The recent interest in stellar chromospheres and coronas has been generated by recent satellite observations of ultraviolet and x-ray radiation from stars. Solar observers have had such data for many years from satellites. The importance of the magnetic fields for the existence and the heating of these outer regions of the stars and the sun is now quite evident, although the exact mechanism for the heating of the corona still eludes us. In a comprehensive review, J. L. Linsky outlines the nature of stellar chromospheres and coronas and their distribution in the Hertzsprung-Russell diagram and lists the important stellar parameters that determine their properties.

The section on solar and stellar variability is highlighted by a thorough review of the topic by A. Skumanich and J. A. Eddy. It is now well established that many stars go through "activity cycles" that are apparently identical to that of the sun. The periods of these cycles are not far from the 11-year period of the solar cycle. This was first shown in the work of O. C. Wilson, which covered a period of many years. The activity level of stars is judged from the amount of emission in the cores of the H and K lines of ionized calcium, which are formed in the chromosphere.

The volume will make a good reference book for students and scientists. Of course in a rapidly advancing field a volume such as this becomes outdated quickly, and it is true that a greal deal has happened since the meeting (especially in solar and stellar activity). Nevertheless the papers are, to a large extent, solid reviews of the fundamental aspects of the field, so the book reads more like a textbook than a symposium proceedings.

In his concluding remarks, E. N. Parker, who always chooses his words carefully, states, "This has been about the most rewarding meeting I have ever had the pleasure of attending." The assiduous reader will share this enthusiasm.

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Microbial Adhesion to Surfaces

Bacterial Adherence. E. H. BEACHEY, Ed. Chapman and Hall, London, 1980 (U.S. distributor, Methuen, New York). xii, 466 pp., illus. $69.95. Receptors and Recognition, Series B, vol. 6.

The number of recent books dealing with microbial adherence attests to the widespread interest in the subject. The present book concentrates on the adherence of bacteria to animal tissues, although there is a paper by Fletcher on adherence of marine microorganisms to smooth surfaces and one by Lippincott and Lippincott on microbial adherence in plants.

The idea that bacteria accumulate on solid surfaces because the highest concentrations of nutrients are found there is well accepted in marine microbiology and in oral microbiology, though it has received less attention in recent years. The use, initiated by marine microbiologists, of quantitative methods in the study of adherence has been exploited by oral microbiologists, as Gibbons and van Houte discuss. The application of quantitative methods has been instrumental in the development of the idea that adherence is often a specific process. This idea recurs in a number of guises throughout the book. The best-documented examples of specificity are those involving the nitrogen-fixing bacteria and plant pathogens, which are described by Lippincott and Lippincott. Extensive documentation of specificity in these organisms has been possible because the stability of the components involved allows the use of extraction techniques that would denature components involved in animal model systems. In addition, of course, plant cells can be grown and manipulated more easily than those of animals. The relationship between fimbriae (pili?) and epithelium in

adherence in the Gram-negative organisms appears to be well documented, again because of the relative ease with which fimbriae can be removed in a biologically active form. However, determining the molecular basis of the activity of fimbriae has not been as easy because extraction procedures often inactivate the active molecules or result in such a complex assortment of adhesive substances that analysis for the active component is difficult. Many of these problems also occur in the attempts to determine the nature of the host-cell receptor. Thus, many of the data presented concerning the interaction between Gram-negative fimbriated organisms and host cells come from studies that rely upon hapten inhibition and enzymatic hydrolysis, both of which may lead to erroneous conclusions. In many studies, a hemagglutination test is used despite the observations that adherence to erythrocytes often appears to be mediated by different bacterial adhesins and host receptors from those mediating adherence to epithelial cells. The problems in the interpretation of these types of experiments are well illustrated in chapters 9 and 10, which cover much of the same ground but with clearly differing conclusions. Thus, Watt and Ward (chapter 9) conclude that adhesion of *Neisseria gonorrhoeae* is mediated by hydrogen bonding along the sugar moieties, whereas Pearce and Buchanan (chapter 10), citing similar evidence, conclude that the interaction is more specific and involves a lectin-like receptor.

I was happy to be introduced in chapter 9 to the use of DLVO (Derjaguin-Landau-Verwey-Overbeek: long-range attraction) theory as a way of explaining the affinity between two like-charged cells. The difficulty of explaining such affinity is discussed in some detail in the introductory chapter by Ofek and Beachey. Of most interest to me was their discussion of the adhesion of the Gram-positive organisms, particularly the streptococci. Although the authors suggest that teichoic acids are important in the attachment of these organisms to epithelial cells, the difficulty of removing the surface components of the streptococci without denaturing them suggests that the complete story has not yet been written. Thus, the book is thought-provoking, and, best of all, I learned something.

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A Regulatory Protein

Calmodulin and Cell Functions. Papers from a conference, New York, May 1980. D. MARTIN WATTERSON and FRANK F. VINCENZI, Eds. New York Academy of Sciences, New York, 1980. xii, 446 pp., illus. Cloth or paper, $86. Annals of the New York Academy of Sciences, vol. 356.

Calcium ions have long been implicated in the regulation of such biological processes as contraction, motility, secretion, metabolic adjustment, and cell proliferation. Recently it has become evident that their effects are mediated through a family of structurally related Ca^{2+}-dependent regulatory proteins of common evolutionary origin. Whereas some representatives of this family are specialized and are found only in certain tissues (for example, troponin C in muscle tissue), calmodulin is apparently found in all nucleated cells and serves as a general receptor for the Ca^{2+} signal. Since its discovery a decade ago as an activator of brain cyclic nucleotide phosphodiesterase, calmodulin has been "rediscovered" by a number of investigators as a protein factor that could enhance Ca^{2+} activation of the particular biological system under study. The present book is an attempt to summarize current research on calmodulin and to define future research areas.

Since the conference of which the book is the proceedings attracted representatives of most of the major laboratories involved in calmodulin research either as featured speakers or to give poster presentations (abstracted in the volume), the objective of summarizing current research has certainly been met. Also, many of the papers contain speculative sections that point to possible future developments. Although the quality, scope, and thoroughness of the contributions vary greatly, the standard is generally high, and it would be impossible in a short review such as this to do justice to the many excellent papers contained in the volume. Suffice it to say that the significance and role of calmodulin in the regulation of neurotransmission, cyclic nucleotide metabolism, membrane transport, calcium levels, and smooth muscle contraction are dealt with very adequately by a number of authors.

In addition there are several interesting contributions dealing with such topics as structure-function relationships and mode of action of calmodulin (Jamieson *et al.*, Drabikowski *et al.*, Nairn *et al.*), comparative studies of calmodulin and calmodulin-like proteins (Van Eldik *et al.*), and the isolation and molecular cloning of a portion of the calmodulin gene (Munjaal *et al.*).

Though unavoidably out of date, the book complements the several excellent reviews recently published on the subject because it fills in the details of experimental manipulations and approaches that cannot be found in those reviews. For this reason and because it provides easy and organized access to the calmodulin literature, the book will be extremely useful, and indeed "a must," for anyone who considers entering the field. It will also appeal to anyone generally interested in the regulation of cell function.

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