Constant develops his subject with care—perhaps too much so. Fully 98 pages of text are devoted to predecessor technologies. Another 80 are consumed by a useful but at times overextensive discussion of currents within aeronautical research, including commercial air transportation, the revolution in aircraft structures, international competition in aeronautics, and the like. Finally, Constant begins his discussion of the turbojet revolution on p. 179, discussing the background and work of its four parents: Frank Whittle, Hans von Ohain, Herbert Wagner, and Helmut Schelp. Here one of Constant's most important conclusions is forcefully conveyed: the turbojet revolution was the product of men operating outside the traditional aeroengine community; yet they acted really as catalysts, for once they had demonstrated the principles with test-bed engines and rudimentary flight vehicles responsibility for their utilization returned to established industry. This reviewer was mildly disappointed by the rapid denouement of the book. The discussion of the first aircraft to benefit from the turbojet technology consumes only ten pages. Several tantalizing questions are left unanswered. For example, what was the feeling of military commanders with regard to the potential of turbojet aircraft? Was there reluctance on the part of high-level Allied leaders to develop and deploy turbojet aircraft? Only Britain among the Allied nations fielded jet aircraft in combat, and these were inferior to Germany's outstanding wartime jet fighter, the Me 262. The United States, a firm third in the turbojet race, drew level with European efforts only at the war's end. The reasons for the American failure to proceed with jet development are complex and to a significant degree shaped postwar American military attitudes toward America's scientific community, which was, rightly or wrongly, perceived to have "failed" in spotting the potential of the turbojet as a high-performance propulsion system. A section on these and similar questions would have rounded out the discussion nicely. As it is, readers can still examine Robert Schlaifer's *Development of Aircraft Engines* (Harvard University Press, 1950) for a cogent discussion of why the United States was last in the international turbojet sweepstakes. Alex Roland's forthcoming history of the National Advisory Committee for Aeronautics examines the impact of NACA's failure to forecast the significance of the turbojet engine on its postwar relationship with the military.

In sum, Constant has written an excellent work that suffers from some structural unevenness. Perhaps too exhaustive in its beginnings, the book ends abruptly, with the final thoughts hammered home quickly, and only briefly examined. But this is a minor flaw. Models of technological change have become so commonplace that one fears for the value of a text when one sees yet another, but Constant has developed a thoughtful model, letting his evidence take him where it will and not bending his interpretation to fit a schema. While not totally supplanting Schlaifer's work, Constant has given us what is unquestionably the finest examination of the turbojet revolution to date. He is to be commended not only for his selection of the topic but for his handling of it.

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Solar Physics

Solar Flare Magnetohydrodynamics. E. R. PRIEST, Ed. Gordon and Breach, New York, 1981. xii, 564 pp., illus. $89.50. The Fluid Mechanics of Astrophysics and Geophysics, vol. 1.

The solar flare is an extremely complex phenomenon that causes a transient change of a substantial fraction of the solar atmosphere. The change involves the conversion of roughly 10^{32} ergs, for a large flare, of supposedly magnetic free energy in approximately 100 to 1000 seconds spread over a volume of more than 10^{30} cubic centimeters. The flare plasma resulting from this rapid deposition of energy is a highly complex mix of quasithermal and nonthermal particle populations embedded in an exponential atmosphere whose transport properties, even without the ever-present magnetic fields, vary by orders of magnitude from the highly resistive temperature minimum to the almost perfectly conducting corona. The theoretical treatment of such a complex phenomenon results in highly controversial points of view. *Solar Flare Magnetohydrodynamics* represents one view of the subject.

The book consists of a collection of specialized papers devoted to topics of general interest in solar flare theory. Although the preface states that the book is aimed at first-year graduate students, it is not suitable for such an audience, for reasons to be discussed below. The book consists of eight chapters, including a 45-page introduction by the editor. The other chapters are "Flare observations" by Z. Švestka, "Current sheets" by Priest, "Simple-loop flares: magnetic instabilities" by G. van Hoven, "Simple-loop flares: thermal evolution" by I. J. D. Craig, "Two-ribbon flares: magnetostatic equilibria" by J. Birn and K. Schindler (with a section added by the editor describing his own work), "Two-ribbon flares: (post)-flare loops" by G. W. Pneuman, and "Particle acceleration in solar flares" by J. Heyvaerts.

The introduction clearly demonstrates the complexity of the flare phenomenon, as well as the "cartoon approximation" so prevalent in solar physics. Unfortunately Priest does not attempt to assess where solar flare theory is going and how to get there. In fact there is no discussion anywhere in the book of what a realistic theoretical approach to solar flares should encompass.

The review of solar flare observations by Švestka is well organized and compact. It is an excellent update of his highly praised book on the subject. The reader should read this chapter before attempting the others.

It is sometimes amusing to compare Švestka's review of the observations with the way the observations are convoluted to fit the pictures drawn by theoreticians. The review of current sheet theory by Priest leaves one with the impression that the solar flare as a phenomenon would be well understood if only the observationalists would get down to business and locate the reconnecting current sheet that will neatly explain all those misleading observations reviewed by Švestka. Though useful as an introduction to current sheet theory, the chapter is well out of date with respect to anomalous transport occurring in sheets, the effect of mode coupling between differing reconnecting sheets, and magnetic stochasticity caused by the coupling process. The chapter also suffers from the author's never citing references to the works of the many authors he invokes.

The chapter by van Hoven is more appropriate to a textbook reviewing the magnetohydrodynamic stability of tokamaks or reversed field pinches. The justification for devoting 56 pages to reviewing one-dimensional stability analyses of what are clearly three-dimensional structures, such as loops, and calling the analyses global (they are in fact local) is anyone's guess. The author apparently believes that flaring loops are half a symmetric tokamak or reversed field pinch embedded in the sun.

The chapter by Craig is clearly pre-

sented and is an excellent guide for any beginner to the field. Craig describes in depth many of the objectives and problems associated with the thermal modeling of solar flare loops. The chapter by Birn and Schindler reviews quite successfully the current theoretical approach to pre-flare evolution of magnetic structures in the solar atmosphere.

Pneuman's chapter is a mixed blessing. He successfully reviews the present observations concerning post-flare loops. However, his presentation of theoretical models for the formation of these loops, though quite lucid, gives the impression that the issue is settled even though it is still highly controversial. Nevertheless the chapter is educational.

The chapter by Heyvaerts is a masterly review of many of the most complex flare problems. It is highly recommended. The only proviso is that many of Heyvaerts' comments represent his views of a subject about which agreement has not yet been reached.

In summary, the book can be useful for the experienced researcher in solar physics, but not as an introduction to the subject of solar flare theory.

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Microbiology

Contemporary Microbial Ecology. Proceedings of a symposium, Coventry, England, Sept. 1980. D. C. ELLWOOD, M. J. LATHAM, J. N. HEDGER, J. M. LYNCH, and J. H. SLATER, Eds. Academic Press, New York, 1980. xviii, 438 pp., illus. $41.

Modern microbiology has traditionally been a series of weakly connected disciplines. Less than ten years ago, for example, marine microbiologists had little contact with medical microbiologists. However, within the past decade a process of integration has begun. The term "microbial ecology" is used increasingly to describe the study of the comparative activities of microorganisms in a wide range of natural habitats. Concepts are discussed that are equally applicable to soils and salt marshes.

It is not surprising that the development of this active new field would spawn international symposiums. The first of these was held in New Zealand in 1977. The proceedings (*Microbial Ecology*, M. W. Loutit and J. A. R. Miles, Eds., Springer-Verlag, 1978) emphasized the individual disciplines contributing to microbial ecology. There were, for example, sections devoted to freshwater and marine ecosystems as well as to animal and plant microbiology.

Contemporary Microbial Ecology is a set of 19 papers based on keynote lectures given at the second international symposium. The conference marked an important turning point in the field. The first generation of microbial ecologists were primarily microbiologists trained in general microbiology or physiology. The new generation has a broader base. In addition to microbiology and biochemistry, they are well versed in genetics, population biology, and evolutionary theory.

The papers in this book reflect this new sophistication. There is a perceptive paper on microbial adaptation and selection by Slater and Godwin in which the complex kinetic, biochemical, and genetic factors controlling microbial community structure are discussed. Konings and Veldkamp consider the difficult subject of phenotypic responses of microbial cells to environmental change. In a fascinating paper on form and function in prokaryotes, Dow and Whittenbury attempt to define functional relationships between bacteria in biochemical and physiological terms.

The book also provides analyses of the extraordinarily wide range of survival strategies available to microorganisms. There are papers on aerial dispersal (Lacey and Gregory), symbiosis (Gooday and Doonan), and antagonism (Baker). A paper by Carlile explains the ecological implications of microbial chemotaxis and other sensory responses to environmental stimuli. Williams, in a paper entitled "On understanding predator-prey interactions," attempts to reconcile the approaches to predation of the microbiologist and the ecologist. His perceptive discussion points clearly to the dangers of interlacing microbiological and ecological theory, at least where predator-prey relationships are involved.

Specific habitats are treated in excellent papers on human pathogens (Jones), intestinal microorganisms (Bauchop), and the plant rhizosphere (Bowen). Kushner's paper on the survival strategies of bacteria living in extreme environments provides beautiful examples of the plasticity and resilience of microbial communities in response to stress. Apparently some bacteria can adapt biochemically to survive conditions, such as extreme heat, cold, saline environments, or pressure, that are lethal to most organisms. Recent work on interfaces as microbial habitats is reviewed by Marshall.

Extensive treatment is given to microbial transformations in soil and water. There are papers on nutrient and energy flow through soil (Paul and Voroney) and marine sediments (Jørgensen) as well as on bacterial energy conservation (Jones) and biodegradation of organic compounds (Bull).

My only criticism of this excellent book concerns its omissions. The vitality of the symposium reflects the input of young microbiologists, and the volume might have included more of the papers presented by younger, less established researchers.

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Paleobotanical Progress

Paleobotany, Paleoecology, and Evolution. Papers from a symposium, Ithaca, N.Y., Nov. 1979. KARL J. NIKLAS, Ed. Praeger, New York, 1981. In two volumes. Vol. 1, xxii, 298 pp., illus. $37.50. Vol. 2, 280 pp., illus. $36.

This is a timely book in that it brings together significant contributions from fields of evolutionary biology between which there has traditionally been too little interaction. Although the emphasis is on paleobotany and plant paleoecology, with chapters spanning geological time from the Precambrian to the Neogene, there are also contributions dealing with liverwort evolution by reference to comparative morphology and phytogeography, molecular genetics in the context of species durations, and biochemical evolution in early land plants. The book is published in honor of Harlan Banks, recently retired from Cornell University, who is remarkable not only for his outstanding work in paleobotany but also for his infectious enthusiasm and his generous and warm personality both as a teacher and as a colleague. In view of the dedication, it is perhaps surprising that there is not a greater representation of paleobotanists and others who have been among Banks's numerous students and collaborators. The book is an entirely American production in that all the authors are either American or have accomplished most of their scientific work in the United States. The reason for this is probably simply that the papers were presented first at a symposium held in the United States, but it seems a little unfortunate in view of Banks's international acclaim.

Paleobotany has had until recently and