tween individualism and uniformity in American culture, including racial, sexual, sectional, and intellectual conflicts. Warner briefly discusses several of these larger themes. But, perhaps in reaction against the kind of social reductionism that would portray therapeutic discrimination as nothing but the medical reflection of social prejudices, he takes pains to emphasize that such variations had their roots in the internal dynamics of the medical profession. The point is important and correct, but the emphasis placed on it minimizes significant links of medicine with other professions and with larger cultural forces.

Combining a prodigiously researched and thoroughly fascinating depiction of actual 19th-century therapy with a sophisticated and widely applicable model of scientific change, *The Therapeutic Perspective* is a superb book, likely to become a classic in the literature of medical history.

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## Records of the Maya

**The Murals of Bonampak**. MARY ELLEN MILLER. Princeton University Press, Princeton, NJ, 1986. xviii, 176 pp., illus., + plates. $67.50.

In *The Murals of Bonampak* Mary Miller has been forced to study these deteriorating Maya wall paintings almost as if they were a lost monument. Located on the interior walls of the three rooms of Structure 1 at Bonampak, Chiapas, Mexico, the paintings were found in May 1946, and Miller details both the sensational international attention they initially attracted and their subsequent ruin as final responsibility for their preservation was taken by no single agency, and as tourism proved destructive. The murals are now covered with an opaque calcified coating resulting from a millennium of seepage through the structure's limestone walls and vaults, and in order to see them copyists made this coating transparent by soaking it with kerosene or water. The murals have been copied four times and photographed extensively. Miller's art-historical study is based on these copies and photographs and is thus generally confined to iconographic and formal (or compositional) analysis, rather than including discussion of variations in painterly style, technique, or pigments. (Miller was apparently unaware of the existence of a superb set of color transparencies available through the Instituto Latinoamericano de la Communicacion Educativa of Unesco; these are probably the ones taken by Hans Ritter that she describes as lost.)

The first and most ambitious study of these murals was published by the Carnegie Institution of Washington in 1955; here the eminent Mayanist J. Eric S. Thompson discussed the subject matter of the murals. Since Miller's work is her dissertation, it is not surprising that it is revisionist and critical of both Thompson and the Carnegie Institution of Washington. Foremost is Miller's objection to Thompson's belief that the Maya were not very warlike and that the spectacular battle depicted in Room 2 at Bonampak was a raid for captives, rather than war (p. 96). After refuting Thompson's analysis Miller nevertheless concludes her description of this engagement by arguing that the capture of prisoners was its goal (p. 111). More important than such quibbles over terminology is Miller's innovative conclusion (based on the research of Floyd Lounsbury) that the date of this battle was determined by the heliacal rise of Venus and that the paintings on the north wall of Room 2 are both compositionally and symbolically the equivalent of the glyph known as "shell/star" that signifies war.

Miller has convincingly settled the disputed reading order of the paintings in the three rooms and of the walls within the rooms. She describes Structure 1 as a monument erected to glorify the reign of the Bonampak ruler Chaan-Muan, at the end of the eighth century A.D., and she identifies him in Rooms 1 and 3 in association with the presentation of an heir and in Room 2 participating in and presiding over the capture, torture, and display of prisoners.

The inscriptions in these paintings should help resolve lingering questions about the interpretation of these scenes; there is a single long one with a date, and many captions identify participants. Miller devotes a valuable separate chapter to recording and discussing these inscriptions, but because of poor preservation and the less familiar cursive style they provide frustratingly little hard information, and it is unfortunate that they are not brought together with the discussion of the figures that they identify in the next three chapters. Here Miller has undertaken the staggering task of numbering, describing minutely, and discussing over 300 figures, although key details of her description are often invisible in the illustrations provided. The comparative iconographic discussion is magnificent, and archeologists are served with a banquet of Maya material culture in all the objects illustrated in these paintings. For instance, processions of musicians are included in Rooms 1 and 3, and Miller analyzes the Maya ritual band, its requisite rattles, drums, trumpets, and their invariable marching order; and one of her most original contributions is the analysis of all the textile and hide clothing worn, and of its techniques of design and construction, with an estimate that 600 yards of cloth is worn in Room 1 alone. *Murals of Bonampak* excels in the richness of its historic and iconographic analysis and in its evocation of the meaning, the sights, and the sounds of Classic Maya dynastic ritual and display.

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## Fluid Mechanics

**Wave Interactions and Fluid Flows**. ALEX D. D. CRAIK. Cambridge University Press, New York, 1986. xii, 322 pp., illus. $59.50. Cambridge Monographs on Mechanics and Applied Mathematics.

The theory of wave interactions was first developed about 25 years ago in the context of nonlinear free-surface waves. Now it is widely recognized that nonlinear wave interactions play an important part in a variety of wave and instability phenomena, with applications in geophysical fluid dynamics, meteorology, flow instability and transition, and plasma physics. This book focuses attention on wave interactions in fluid flows and discusses both the general underlying ideas and some applications, dealing primarily with surface waves, internal waves, and shear-flow instability. The book is divided into eight chapters. The main discussion starts in chapter 2, which is devoted to linear concepts and shows how some stratified-flow stability phenomena can be understood in terms of linear wave interactions or mode coupling. Chapters 3 and 4 discuss the nonlinear interaction between a finite-amplitude wave train and an underlying mean flow, including the generalized mean Lagrangian approach and the conservation of wave action. Particular examples from free-surface and internal waves, including the Craik-Leibovich theory of Langmuir circulations, are mentioned. Chapter 5 deals with resonant triad interactions, the first problem to be tackled in the early '60s, which provided incentive for further research in the area of nonlinear interactions. The basic theory of conservative and nonconservative resonant triads is discussed together with more recent applications on long-short wave interactions and shear-flow instability. Chapter 6 is devoted to the evolution of nonlinear wave packets; particular emphasis is placed on the most important equations in this

area, the nonlinear Schrödinger equation and the Korteweg–de Vries equation, which have wide applicability. Chapter 7 presents a discussion of higher-order interactions, quartets in particular, with applications in Taylor-Couette flow between rotating cylinders and Rayleigh-Bénard convection. Finally, in chapter 8, the author indicates some open questions on shear-flow instability and transition to turbulence, together with some of his own thoughts on how these problems should be approached.

This research monograph summarizes and reviews the large body of work on wave interactions that has accumulated over 25 years of intensive study. No effort is made to present the material in a pedagogical way. Accordingly, this is definitely not an elementary textbook; it could serve as a reference for researchers working in the field of wave interactions or in an advanced graduate course. I enjoyed reading this book; the discussion of the topics that I am familiar with served as a refreshing, integrated review; the rest of the discussion outlines the important developments and gives enough references to get someone started who is seriously interested in exploring the subject in more detail.

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## Productivity in Plants

**On the Economy of Plant Form and Function.** THOMAS J. GIVNISH, Ed. Cambridge University Press, New York, 1986. xviii, 717 pp., illus. $84.50. From a symposium, Harvard Forest, Aug. 1983.

This volume is the proceedings of a symposium on "Evolutionary Constraints on Primary Productivity: Adaptive Patterns of Energy Capture in Plants." The 27 contributors have produced 20 chapters that consider how a wide range of plant traits influence whole-plant productivity and usually, by inference, competitive ability. The biological coverage is very broad, ranging from photosynthetic cyanobacteria to angiosperms and, occasionally, herbivores. Though the majority of the text is allocated to terrestrial vascular plants, three chapters consider aquatic photosynthetic organisms.

Most of the chapters utilize some form of model to conduct a cost-benefit analysis of the traits considered. As might be expected, these analyses vary greatly in form, ranging from anecdotal to formal mathematical models. Several papers include nitrogen as a currency in the cost-benefit analyses (Field and Mooney, Cowan, and Pate). These analyses suggest that in the future leaf nitrogen content should be more routinely quantified during gas exchange studies, particularly in the plants' native habitats. It is clear that in most plants that have been studied nitrogen is an important determinant of the biochemical contribution to photosynthetic capacity. In a chapter that should be required reading for enthusiasts of biotechnology, Pate lists the potential benefits of symbiotic nitrogen fixation. He then proceeds to show in how many ways the costs of the symbiosis can be disadvantageous to the host plant except under relatively special ecological circumstances.

For the past 30 years the energy balance approach has been used to integrate the various energy transfer processes to explain the relationships between leaf morphology and other properties, environment, leaf temperature, transpiration rate, and metabolism. This quantitative approach to analyzing the adaptive significance of habitat-related changes in leaf structural, diffusional, and optical properties provides excellent agreement (Ehleringer and Werk; Nobel) with direct observations of the characteristics of arid zone plants in their native habitats. However, adaptation to existence in the profound shade of humid tropical forests (Lee) provides many future research opportunities. Models are now being used to extend our understanding of the relationship of variations in anatomy (Parkhurst) to metabolism, as well as the relationship of leaf gas exchange properties to whole-plant patterns of energy allocation (Givnish).

Quantitative understanding of the functional significance of whole-plant root systems remains a challenge although new methods of study (Caldwell and Richards; Fiscus) are providing hypotheses. The present level of understanding suggests that the timing and spatial distribution of root growth are important determinants of nutrient and water uptake.

In an appropriately cautious chapter, Baas points out the difficulty of testing hypotheses of the adapative significance of various characteristics of xylem. He calls for a great increase in experimental approaches to xylem studies.

Analyses of canopy architectural properties and biomechanical properties continue to provide useful quantitative insights into the costs and benefits of particular canopy designs over a range of different environments (Raven, Fisher, and Givnish). These analyses have been extended to marine seaweeds (Koehl, Hay) and have illustrated how sometimes apparently subtle variations in morphology can have potentially large effects on productivity and susceptibility to damage. As is the case with terrestrial plants, the available field observations for seaweeds show that the distributions of types of morphology do appear to be correlated with habitat differences as predicted by theory.

In a thoughtful essay Schulze, Küppers, and Matyssek point out in several ways how misleading it can be to attempt to construct an adaptive argument that is based on optimizing carbon gain alone. They point out that many plants with low photosynthetic rates can be successful competitors. Their chapter clearly points the way for a new level of integration of energy balance, carbon balance, nutrient balance, and water balance in physiological studies.

The direct and indirect costs of chemical defenses suggest that in short-lived plants only small amounts of carbon can be allocated to defense compounds, otherwise the loss of productivity could be disadvantageous (Gulmon and Mooney). This offers another view of the differences in defense chemistry between short- and long-lived plants.

In many of the chapters the (usually limited) available field observations agree with the predictions of theory. However, the authors repeatedly emphasize the need for experimental studies in the plants' native habitats to extend our understanding and to test the hypotheses more rigorously. In this regard this volume is a rich source of ideas and opportunities for future work. Most potential readers will already be familiar with some of its content. It is a good synthesis, and many of the chapters are good points of departure for new research or for graduate seminar discussions.

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## Books Received

**Acoustic and Electromagnetic Waves.** D. S. Jones. Clarendon (Oxford University Press), New York, 1986. xx, 745 pp., illus. $145.

**AIDS.** Facts and Issues. Victor Gong and Norman Rudnick, Eds. Rutgers University Press, New Brunswick, NJ, 1986. xx, 388 pp. $25; paper, $10.95.

**Biomedical Engineering V.** Recent Developments. Subrata Saha, Ed. Pergamon, New York, 1986. xviii, 536 pp., illus. Paper, $70. From a conference, Shreveport, LA, Oct. 1986.

**Biomimetic and Bioorganic Chemistry III.** F. Vögtle and E. Weber, Eds. Springer-Verlag, New York, 1986. x, 166 pp., illus. $61.60. Topics in Current Chemistry, 136.

**Biophysical Effects of Steady Magnetic Fields.** G. Maret, J. Kiepenheuer, and N. Boccara, Eds. Springer-Verlag, New York, 1986. xii, 231 pp., illus. $46.20. Springer Proceedings in Physics, 11. From a workshop, Les Houches, France, Feb. 1986.

**Biopolymers/Non-Exclusion HPLC.** J. D. Andrade *et al.* Springer-Verlag, New York, 1986. x, 232 pp., illus. $82. Advances in Polymer Science, 79.

**Biotechnology and the Environment.** Research Needs. Gilbert S. Omenn and Albert H. Teich, Eds. Noyes, Park Ridge, NJ, 1986. x, 169 pp., illus. $36. A