new facts and interpretations. I think it is fair to say, however, that my concepts of regulatory mechanisms in plant development were not much altered by this presentation. This is by way of saying that despite a wealth of new material, especially biochemical, fine structural, and morphogenetical, we are still pretty much in the dark about the ultimate mechanisms that control the orderly unfolding of differentiational events. We await new findings, new hypotheses, new paradigms.

I especially enjoyed the chapters on genetic control of the sexual reproductive apparatus in *Neurospora* by A. M. Srb *et al.*, Beatrice Sweeney's chapter on temporal regulation of morphogenesis in plants, Pickett-Heaps and Tippit's chapter on desmid morphogenesis, G. L. Stebbins's masterly chapter on the evolution of morphogenetic patterns, Redei *et al.*'s chapter on mutants, metabolites, and differentiation, Ford's chapter on supergenes, and H. H. Smith's chapter on interspecific plant hybridization and the genetics of morphogenesis.

This is an interesting collation that will be especially valuable to those morphogeneticists who are not immersed in botanical lore. It is balanced, scholarly, and, despite an economical paper cover, attractively compiled. It will reward the systematic and devoted reader.

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Aspects of the Cell Wall

The Physical Biology of Plant Cell Walls. R. D. PRESTON. Chapman and Hall, London, 1974 (U.S. distributor, Halsted [Wiley], New York). xiv, 492 pp., illus. $35.

Without cell walls plants as we know them could not exist. It is the strength of the wall that protects cells from the crushing weight of the aerial parts of trees. The walls relieve plant cells of the necessity for energy-draining osmoregulation by constraining the cell contents. Yet the walls must be extensible enough to allow the cells to grow and elastic enough to allow the cells to cope with wind and with a constantly fluctuating water status. How do the walls accomplish all these feats? We will not know until their chemistry, ultrastructure, and physical properties are better understood.

In the 1950's attention was concentrated on the ultrastructure of the wall. Three major books appeared detailing the results of such studies, first Preston's *Molecular Architecture of Plant Cell Walls* in 1952, and then in 1959 books by Frey-Wyssling and Roelofsen. Since then attention has shifted toward the chemistry and biosynthesis of cell walls, but no comparable books summarizing these studies have yet appeared. Now Preston has brought forth an updated and revised version of his book. It is probably not the book most needed at present in this field, but it is, nevertheless, a significant one.

As Preston points out in the introduction, the book makes no attempt to cover every aspect of cell walls; in fact it does not even cover all aspects of the physical biology of walls. What it does do is summarize as no other publication has done the extensive studies that have originated in Leeds. It is a fitting summary of the work of one of the great pioneers and most active workers in this field. Anyone wanting to understand plant cell walls will have to read and digest the wealth of material covered in this book.

More than half the book is devoted to the molecular architecture of the fibrillar components of the wall. It has long been recognized that the physical properties of the walls are directly related to the structure of these microfibrils and the way in which they are incorporated into the wall. This subject is introduced by three chapters detailing the techniques used in such studies, for example, polarization microscopy and x-ray diffraction. The idea is good, but the information will be of value only to those readers with a good background in physics and mathematics. The heart of the book is the three chapters detailing the studies on the orientation of microfibrils in the primary walls of algae and the secondary walls of higher plants. There is no place where this work is more clearly or thoroughly summarized. Anyone interested in cell walls will want this book if only for these three chapters.

The second major topic covered is the mechanical properties of cell walls: the elastic properties of secondary walls and the relation between microfibril orientation and growth of primary walls. The treatment of this topic is not nearly as successful. A lack of information about techniques or about the distinctions between viscoelastic, elastic, and plastic properties and a lack of basic information about the stresses and strains that cells normally undergo make this section difficult to read and comprehend.

Potential readers should be aware that on several matters Preston presents one-sided arguments, for example concerning whether the 3.5-nanometer elementary fibrils of cellulose are an artifact and whether cellulose is synthesized on oriented, plasmalemma-bound particles rather than in Golgi vesicles. In each case equally persuasive arguments supporting other views can be found by reference to the papers of other workers. Although up to 70 percent of primary walls is composed of the nonfibrillar matrix, readers will look in vain for much information about how this matrix is arranged in the wall or how it contributes to the mechanical properties of the walls. Those interested in fungi or other tip-growing cells will have to go elsewhere to find information about their ultrastructure or mode of cell enlargement. There is still room for another book on the physical properties of cell walls, although in the areas of Preston's expertise it will be difficult to improve on this one.

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Applied Mathematics

Linear and Nonlinear Waves. G. B. WHITHAM. Wiley-Interscience, New York, 1974. xviii, 636 pp., illus. $22.50. Pure and Applied Mathematics.

The study of waves has a long history, and many of the classical and modern techniques in applied mathematics have their origins in wave phenomena. The names of Stokes, Riemann, Boussinesq, Rayleigh, and, more recently, Korteweg and de Vries are standard references in the current literature. Until now the only available publications have been ones based on conference proceedings and lecture series. The book under review is a welcome and much-needed addition.

Although this book is intended as a text for graduate students in applied mathematics, it will also be an invaluable companion to any serious worker in the field. There is no other single source that contains so many topics treated from a unified viewpoint.

The book is divided into two parts. In the first, which deals with hyperbolic waves, there is a very readable presentation of the theory as applied to hyperbolic systems. Applications to a broad variety of phenomena, including the standard cases of traffic flow, gas dynamics, and shallow-water waves, are delineated. It is in the study of dispersive waves that there has been intense activity in the past few years. Much of this activity has been prompted by Whitham's own research on finite amplitude periodic wave trains and the use of variational methods. The second part of the book also includes a discussion of the elegant methods used for some equations of special interest (in particular Korteweg–de Vries and Sine-Gordon) that can be solved by making use of results from inverse scattering theory.

Many of the significant developments in the study of nonlinear waves have occurred within the past ten years and have immediate implications in a variety of disciplines. It is especially appropriate to have a researcher who has originated many of these new developments survey the field at this time.

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