a plethora of (for example) later Archaic cultures. Thus, this book represents an extension of the senior author's major contributions, and the new, vital input of ten years' work by his colleague and successor as State Archaeologist. (Although the book is dated 1973 and was released in early 1974, the writing was completed in 1971.)

For all but the Northeast specialist the book stands quite well on its own, by virtue of its straightforward presentation of major sites and the brief holistic summary it gives. Perhaps a certain imperial attitude on the part of the authors may be forgiven, for both of them have elsewhere demonstrated an exceptional grasp (and proper crediting) of the literature and of archeological materials and they have often "said it first" in their region. Moreover, because of the remarkable diversity of habitat that New York State encompasses (ocean coast, large rivers, interior mountains, interior lakes and marshes, Great Lakes plains and shoreline) their summation well represents much of the Northeast.

The general reader, as well as the specialist, will appreciate the many well-chosen and (with a few exceptions) nicely reproduced illustrations of sites, artifacts, chronological relationships, and settlement patterns. The general reader will also enjoy the portion of the book in which models of prehistory are presented. For example, he may well be unaware of the beautifully revealed overwhelming evidence for the in situ development of the Iroquois. *Zea mays* was introduced to New York State about A.D. 1000, and it, in concert with other factors of lesser importance, caused a population growth, village agglutination, the rise of internecine warfare, and apparently the change from male-oriented societies to matrilineal, matrilocal societies. This fundamental transformation of the proto-Iroquois in economy, ethos, and society was accomplished within a few centuries. The "League of the Iroquois" is probably best understood as a response to new trade relationships engendered by European contact. We can but wonder what unique political systems the late prehistoric peoples of New York State might have generated had that European inoculation not taken place.

It is in this concluding "Interpretations" section that the sweep of this major sample of New World prehistory is most evident. The highlights are in the discussions of the Paleo-Indian, Late Archaic, and Late Woodland stages. Although a lack of evidence precludes extended discussion of the Early Archaic, there are, in contrast, new materials or conceptions pertaining to the Transitional and the Middle Woodland, both of which are periods of interesting change in the aboriginal cultural history of New York State.

Aboriginal Settlement Patterns does suffer, to my mind, from two problems. The first, no doubt resulting from the coauthorship, is a fragmentation of presentation, which, however, pertains mostly to writing styles and not so much to data or interpretation. The second deficiency is the brevity of the explicit discourse on theoretical matters. As succinct as the authors are in their "General Considerations," three pages are insufficient. Obviously, both authors utilize the most recent of the tangible paradigms of settlement and subsistence analysis. Equally, they are particularly sensitive to time, both stratigraphic and cultural. One hungers for explicit discussions of these paradigms (about which other archeologists only seem to theorize without practical outcome).

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Plant Development

Basic Mechanisms in Plant Morphogenesis. Proceedings of a symposium, Upton, N.Y., June 1973. Biology Department, Brookhaven National Laboratory, Upton, N.Y., 1974 (available as BNL 50410 from National Technical Information Service, Springfield, Va.). viii, 430 pp., illus. Paper, $10. Brookhaven Symposia in Biology, No. 25.

The central problem in the study of morphogenesis, what causes differences to arise in cells of identical genetic constitution, is probably the same for all organisms. But although DNA seems to be the unique and universal ultimate genetic material of cells, and although the information encoded in DNA seems to be universally expressed through a similar complex of processes eventuating in synthesis of new proteins, there are many divergences among organisms along the way to the differentiated state. For example, regulation by induction-repression type mechanisms is very well worked out for several prokaryotic organisms, but the general applicability of this type of control to eukaryotes requires considerable additional documentation.

In the world of eukaryotes, plants differ markedly from animals in general developmental pattern. In their terminal and lateral meristems, plants retain active embryo-like centers of cell division throughout their life history. This makes their form much more plastic than that of animals and more susceptible to external regulatory influences throughout the life cycle. Experimentally, plants have the unique advantage that single cells of certain species can be propagated on totally synthetic media; they first form undifferentiated callus cultures, which then, at the experimenter's will, may be caused to differentiate formed organs, leading to an entire plant. This proves beyond any reasonable doubt that cells of the differentiated plant body retain the total genetic message for that species. But one can go even further. The walls of some plant cells can be enzymatically removed, and the resulting naked protoplasts can be coaxed to reconstitute walls and then to go on to develop into an entire plant. While they are in the protoplast stage, these cells may be fused with other somatic cells, and made to ingest macromolecules, including those with informational content; and they may, in short, be made to behave in many respects like the microorganisms with which so much has already been done. As the result of these unique properties, plants have recently attracted the attention of molecular geneticists and students of the control of development.

In June 1973 a symposium was held at Brookhaven National Laboratory to explore "what do we *really* know about morphogenetic processes, and what are the questions which ought to be asked concerning these processes." The organizing committee (Peter Carlson, Harold Smith, Arnold Sparrow, and Jack van't Hof) assembled an extraordinarily interesting and able group of researchers and discussants, who explored all aspects of plant development from the morphological to the genetical and biochemical. Although most of the papers deal with higher plants, there is an interesting group dealing with such fungi as *Neurospora, Schizophyllum,* and *Blastocladiella.* Occasional nonbotanical experts, such as E. B. Ford, are brought in to explore special topics such as "Supergenes: are these ecological operons?"

I went through this volume with great interest and was exposed to many

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