chology and forms the basis for standardized tests of infant development as well as the more familiar IQ tests. However, it is not a necessary feature of developmental theory, and well-articulated theories such as that of Piaget, or work such as Bowlby's on attachment, consider individual differences and rate of development relatively unimportant.

The most provocative position taken by the authors emphasizes the lack of intra-individual continuity (that is, consistency in rate of development) from one time period to the next, especially when the assessments are separated by more than a few months. In many recent studies and reviews, characteristics of the environment that are stable over time (for example social class) are found to be better predictors of long-term developmental outcomes than earlier behavior of the child or specific early events (for example premature birth). The bulk of previous research, including Kagan's earlier work, was based on a linear model of development in which behavior measured at one time was expected to predict similar behaviors at a later time. It is only recently that researchers have begun to realize that such a model assumes that intervening experiences have little effect on the behavior in question or that they have the same effect on all individuals. Not surprisingly, it has been virtually impossible to demonstrate behavioral consistency of this kind, and these assumptions are increasingly recognized as untenable. The study of behavioral consistency in development must now be approached in a different fashion. One solution, typified in this volume, is to conclude that continuity in development is rare and can be found only under highly stable environmental conditions. An alternative is to construct more complex models of development. Current efforts to do the latter appear to be moving in two directions. One is toward a focus on the organization of behavior rather than on single behaviors. Rather than assuming that many behaviors are separate indicators of a unifying underlying disposition, skill, or cognitive structure, such an approach considers the functional relationship of behaviors to each other and to environmental demands. The other trend in recent theorizing is toward elaboration of the role of transactions with the environment in developmental change. In this framework, predictions are made from one transaction to the next and long-term outcomes are predicted only on the basis of repeated and *cumulative* assessments. Although such attempts are under way, they have yet to come to fruition, and a synthesis comparable to that presented here is still in the distant future. It is always far easier to see what is problematic about an articulate model than to construct a new one of greater complexity.

Those who already find the views expressed congenial will find this book persuasive. Those who hold alternative positions will easily find occasions to quibble. A work of this type can serve an important heuristic function by provoking its antagonists to articulate and defend alternative theories. It is incumbent on those who believe that early experiences are more important than later ones, that maturation is of minimal importance, or that behavioral continuity is a major feature of development to take up the challenge posed by Kagan, Kearsley, and Zelazo.

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Anaerobic Plants

Plant Life in Anaerobic Environments. DONAL D. HOOK and R. M. M. CRAWFORD, Eds. Ann Arbor Science, Ann Arbor, Mich., 1978. x, 564 pp., illus. $28.

Since Pasteur's discovery of anaerobiosis in the 19th century, bacteriologists have accepted the notion that the oxygen requirements of bacteria are discrete and variable according to species and circumstances. Terms such as "obligate anaerobe," "facultative aerobe," and "microaerophilic" came to be taken for granted as representing facts of bacterial life and were in time transferred to microbiota generally. Nevertheless, the dicta of Priestley and Lavoisier have deeply imprinted higher-plant and animal physiologists with the notion that the life processes of complex organisms need oxygen—and lots of it.

Certainly the traditional viewpoint shared by most higher-plant physiologists is that the oxygen-rich condition of the atmosphere and of well-aerated soils is a requisite for healthy plants and that flooding, poor drainage, and standing waters lead to unfavorable hypoxic or anoxic conditions. Such was the viewpoint encountered by this reviewer when his research turned toward the study of higher-plant behavior under experimental hypoxia. And such has been the viewpoint expressed in countless botany classes throughout the years.

Therefore it was refreshing, even exciting, to receive this volume, an outgrowth of the first symposium on anaerobiosis and related plant adaptation, which took place at the 12th International Botanical Congress in Leningrad in 1975.

The 18 chapters in the book are diverse in subject, but the main viewpoint is clearly embodied in concluding statements from two of them: "Plants resistant to oxygen deficiency are adapted to utilize the energy of glycolysis and at the same time to render its toxic products harmless," from chapter 5, by T. V. Chirkova, and "The anaerobic effect on plant metabolism is not equal to the inhibition of respiration," from chapter 8, by A. A. Zemlianukhin and B. F. Ivanov.

There is a unity of theme in chapters 2 through 8, all of which are concerned with energetics and the materials and material transformations associated with energy. A substantial portion of this section consists of a single chapter by B. B. Vartapetian, I. N. Andreeva, and N. Nuritdinov that deals skillfully and comprehensively with oxygen stress at the cellular level. Using rice as their principal test object, these authors develop a body of information—both ultrastructural and biochemical—that leads to the conclusion that the rice seedling is a facultative anaerobe. Appropriately, A. Pradet and J. L. Bomsel follow with a sophisticated treatment of adenylate metabolism, energy charge, and glycolysis. There follow, then, contributions concerned with such particulars as ethanol, pyruvate, organic acid, and lipid metabolism and with alcohol and lactate dehydrogenases. These papers are generally of good quality, but one tires of encountering similar metabolic flow sheets on so many pages—and these essentially reproduced from the handiest textbook. This only serves to detract from the real point, namely that successful adaptation of the plant to anoxia requires innovations not in metabolic chemistry but rather in regulation—in utilization of existing proton sinks, in coupling of existing pathways for higher energy yield, and in control of activity in specific enzymes.

There remain a group of papers concerned with ecological or ecophysiological aspects of flooded, anoxic environments. W. Armstrong develops the concept of the "wetland plant," emphasizing ventilation and gas exchange problems; Hook and J. R. Scholtens discuss the adaptation of trees to flood. Finally, B. D. Meet and L. H. Stolzy and R. P. Gambrell and W. H. Patrick, Jr., deal with the oxygen status and redox chemistry of the soil itself.

Beyond Vartapetian's fine introductory chapter, "Life without oxygen," there is no effort at unification or logical order in the arrangement of the contributions. The volume could also have benefited from better indexing and perhaps from a state-of-the-art summary. Nevertheless, this is a welcome collection of important papers, highly relevant to current land and plant use problems.

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Chromatin Structure

Chromatin. Papers from a symposium, Cold Spring Harbor, N.Y., June 1977. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y., 1978. In two volumes. xxxviii, 1260 pp., illus. $80. Cold Spring Harbor Symposia on Quantitative Biology, vol. 42.

In 1973 a symposium on chromosome structure and function was held at Cold Spring Harbor. The subject was revisited in 1977, and the proceedings of this second conference are detailed in these two massive volumes. The differences in approach, techniques, and viewpoint are incredible and attest to the remarkable advances in this field in a period of only four years. What has happened is the sudden emergence and elaboration of the concept of nucleosomes as unitary building blocks of chromatin structure. The nucleosome comprises a defined length of DNA wrapped about a specific complex of eight histone molecules. Most of the chromatin in eukaryotic cells seems to be built up from such simple structures, and the recognition of this fact has provided a framework in which specific questions about higher levels of chromosome structure and chromatin function can now be phrased.

By 1973 the first glimmerings of this concept were emerging, but none of this made its way into the 1973 volume. In the 1977 volume, nearly half of the 119 papers are concerned with aspects of nucleosome structure, and many of the remainder draw heavily on the concept.

The two volumes are divided into groups of from three to 21 papers on common topics. Though the assignments seem arbitrary in a few instances, this arrangement helps organize for the reader what would otherwise be an unwieldy collection. The order of topics is logical and reflects nicely the current status of the field.

To critically review such an immense collection seems impossible to me. There are so many excellent papers, covering such a diversity of topics, that citations of the "best" would be little more than a list prejudiced by the reviewer's special interests. Therefore, I will simply describe the categories of topics covered and discuss how they relate to one another.

The first three sections (and parts of the fourth) are concerned with various aspects of nucleosome structure. A variety of techniques, ranging from x-ray diffraction and neutron scattering to studies of nuclease digestion and hydrodynamics and electron microscopy, have been brought to bear. The result is a fairly coherent picture of the nucleosome as a defined particle.

The topic of higher-order structures is taken up next, initially with concentration on higher-order coiling of fibers of nucleosomes and the putative roles of lysine-rich histones. The section continues with a number of papers on chromosome structure, with the evident aim of bridging the gap between local and overall structures in the chromosome.

A series of papers on "simple systems" is interleaved here. This section is rather a mixed bag; although it does contain papers on what might be considered "simple" systems (SV40, bacterial nucleoids, *Oxytricha* chromatin), it also includes papers that might well have been placed elsewhere in the volumes.

The emphasis then shifts to the problem of transcription. Here the first set of papers, on primary products, lays the groundwork, with emphasis on mechanisms and fidelity of transcription, primarily in the more well-defined systems (such as adenovirus, SV40, and the 5*S* genes in *Xenopus*). There follows a series of papers on regulated systems that deals with those systems in which transcription appears to be under extranuclear control of some kind. This portion of the proceedings closes with a long series of papers on transcriptionally active chromatin. Two general approaches can be discerned here—attempts to devise ways to test for or to separate "active" chromatin from the bulk and attempts to utilize the distinct morphology of some "active" regions (puffs and Balbani rings, for example) to examine the transcriptional process. The impetus for both approaches is the same; only a small fraction of the eukaryotic genome is normally transcribed, and the problem is one of selectively studying a small part of a complex system. To this reviewer it seems that the vital connection between chromatin fine structure (as exemplified by nucleosome organization) and control of transcription has yet to be made. Perhaps it will be the dominant theme in another four years or so.

The proceedings closes with four sections on gene organization, the first two of which emphasize the organization of eukaryotic structural genes as deduced from cloning experiments. The other two sections are devoted to histone genes and to repetitive sequences.

One gains from these volumes a sense of the excitement and rapid movement in the field. Indeed, progress is so rapid that the symposium can be looked at as an "interim report" that provides a complete picture of the status of the field in 1977. To anyone working in the field, these are valuable reference books. To the scientist planning to learn the literature, there is probably no better way to begin to do so than by reading these volumes. Anyone wanting an overview of the field might well be advised to begin by reading Chambon's summary of the symposium.

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The Ocean-Atmosphere System

The Chemistry of the Atmosphere and Oceans. HEINRICH D. HOLLAND. Wiley-Interscience, New York, 1978. xvi, 352 pp., illus. $24.95.

Holland's book approaches its subject more from a geologic than from a chemical point of view. It presents a broad discussion of the material balances of geologic materials as they enter or leave the major earth surface reservoirs: the continents, the rivers, the oceans and their underlying sediments, and the atmosphere and its principal gases. Holland's geologic knowledge is considerable, and his perspective is that of one who likes to view the great forces that govern the whole earth over geologic time. For those of us who may often be preoccupied with microscale chemical mechanisms, geochemical changes on a regional scale, and time periods measured in days or years, it is good to be reminded of this larger view.

Though the book is relatively slim, its six chapters contain roughly 600 references to the earth science literature. A figure or diagram appears on practically every second page of text, a table on every fourth page. Consequently, the book offers a compilation of data on global geochemical relationships as well as a description of large-scale processes.