

in their listings of columns suitable for various separations. All of the authors emphasize that some of the most powerful techniques, both for quantitative separation and for compound identification, depend on the comparison of chromatograms from two stationary phases of widely different types.

Much research has been devoted to the causes of band broadening in gas chromatography, but it is not yet fully possible to predict, from a knowledge of the packing and flow conditions, the efficiency that will be obtained with any given column. Purnell gives the most complete account; the other authors are more selective in their treatments. Resistance to mass transfer in the gas as well as in the liquid phase are recognized and so is the importance of the detailed geometrical distribution of the liquid on the support, even though it is not yet known how to control this latter factor with any assurance. With respect to the many contributions to band broadening, Littlewood points out (p. 143), "When a good column is used in bad conditions it is the badness of the conditions that determines the performance, not the excellence of the column and when a bad column is used in good conditions it is the badness of the column and not the excellence of the conditions that determines the performance."

All of the authors discuss the special features of capillary columns, the use of temperature programming, preparative work, methods of sample introduction, and fraction collection. The discussions on detectors range from 100 pages by Littlewood to 30 pages by Knox. Littlewood provides particularly clear presentations of ionization detectors and of the quantitative aspects of the thermal conductivity detector, and he and Knox give the best descriptions of the electron capture detector. None of the authors cover the microcoulometric detector, of current interest in insecticide analysis, although Dal Nogare and Juvet mention Liberti's earlier coulometric method.

The three larger textbooks devote considerable space to applications. Littlewood organizes these by type of compound—for example, fatty acid esters, sulfur compounds, and an outstanding section on permanent gases and methane. Dal Nogare and Juvet discuss the type of analysis—such as trace analysis, food and flavor, and the like. Purnell selects a few difficult analytical problems, and gives them detailed treat-

ment that will be much appreciated by experienced chromatographers.

Apart from a number of errors in the references given in Purnell's book, the only mistake that I noted was on page 183 of Littlewood's volume where he gives the temperature coefficient for gaseous diffusion as the 0.3 to 0.5 power of temperature instead of approximately the 1.8 power.

The proceedings of the 1961 East Lansing symposium, part of the continuing original literature of gas chromatography, contains 37 papers, Preston's previously mentioned bibliography, and a short but stimulating introduction by M. J. E. Golay. Except for two papers on the theory of programmed temperature gas chromatography, all contributions deal with experimental work. The discussions are included, but unfortunately, they are in a separate appendix at the back of the book rather than with the relevant papers.

*Gas Chromatography Abstracts, 1961*, contains 883 abstracts and, although Preston's bibliography shows about twice as many references for this period, Preston includes all papers where gas chromatography was used at all; it is unlikely that the abstractors have missed any significant developments. As those who use the abstracts already know, one of their most attractive features is the detailed and thorough index. One is happy to read in the introduction that future volumes of the abstracts are likely to appear even more promptly.

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## Jesup Lectures

**New Patterns in Genetics and Development.** C. H. Waddington. Columbia University Press, New York, 1962. xiv + 271 pp. Illus. \$10.

This volume is based on the Jesup lectures delivered at Columbia University in 1961. The title has a double meaning, insofar as the book deals with the origin of new patterns in development. Waddington applies to this problem the new patterns of thought which have arisen in genetics and biochemistry and tries to arrive at new patterns of thought applicable to the baffling problems of morphogenesis. The book is not a textbook, and it does not attempt to treat the vast literature

in the field systematically. It is mainly concerned with presenting and discussing new ideas, which are introduced and developed on the basis of factual data, most of them taken from the most recent literature and from work in the author's laboratory.

Four of the six chapters deal essentially with developmental phenomena at the cellular level. The first chapter discusses the relation of genes and macromolecules and the possible ways in which the action of genes may be controlled in developing systems. In the next three chapters these ideas are related to the changes observed in developing cells under the electron microscope (amphibian notochord, retina of *Drosophila*) and to other information concerning morphogenetic processes in single cells. The concepts of gene action developed in microorganisms are found to be insufficient to account for all the observed phenomena. A particularly difficult problem arises from the fact that an organization of cells—that is, a differential localization of substances in the cytoplasm—can be clearly demonstrated and indeed is necessary to account for differentiation, despite the free flow of cytoplasm seen in living cells. Thus the question of the material substratum for cellular organization becomes difficult to conceive. The final two chapters deal with multicellular systems, particularly with the problems of specific cell aggregation, morphogenetic fields and competence, and pattern formation.

The book is stimulating and interesting throughout, and full of brilliant analyses and ideas. Nevertheless, large parts leave me somewhat disappointed because the great complexity of the phenomena is emphasized and no clear new pattern of thought seems to emerge. Fortunately, chapter 6 reverses this trend; in that chapter's brilliant analysis of the genic determination of the *Drosophila* leg, and in its discussions of the banding of the snail shell and of the lepidopteran wing pattern, the possibility of an interpretation of developmental processes in molecular terms becomes conceivable, even though it has not yet been demonstrated.

The great variety of phenomena described in the book, and the manifold suggestions for their interpretation, raise the question of whether it will be possible, in principle, to describe embryology in terms of general validity, as has been possible in genetics and

biochemistry. The fundamental phenomena studied in genetics and biochemistry seem to be similar or identical in all organisms. The facts mentioned in the last chapter, particularly the selection experiments involving canalization which Waddington has initiated, may suggest that different mechanisms, as indicated by their polygenic determination, may be involved in the control of each developmental process. If this were the case, the physicochemical mechanism of control of a process would be variable, while the more generalized answers would have to be sought in evolutionary considerations.

Unfortunately, the book contains many typographical errors, some of which interfere with easy understanding. However, the large number of illustrations help clarify the observations and interpretations. Twenty-four plates, many of them electron photomicrographs, are included.

All biologists should find the book pleasant, profitable reading, and it will be particularly valuable to those interested in problems of development. By evaluating critically the difficulties and the promises involved in the transfer of ideas from the study of microorganisms to developing metazoan systems, the author has formulated a large number of questions that can be profitably attacked with the means at our disposal.

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## Plant Genetics

**Discussions in Cytogenetics.** Charles R. Burnham. Burgess, Minneapolis, Minn., 1962. iii + 375 pp. Illus. \$8.

*Discussions in Cytogenetics*, according to Burnham, is intended for use in an advanced course in cytogenetics, one which follows courses in cytology and genetics. He further indicates that "it is a supplement rather than a substitute for other books in the field." It should also be pointed out that the manipulation of chromosomes and genomes via correlated genetical and cytological experimental procedures constitute the core of the book.

Plant breeders and cytogeneticists will welcome the publication of this book, a compilation of Burnham's lecture notes at the University of Minnesota where he is a professor of plant genetics.

Burnham proposes that the book will "aid in attaining a working knowledge which will enable the student to read and understand the published research as it appears."

The book is divided into two general sections: (i) changes in chromosome structure and (ii) changes in chromosome number.

The first section, on structural changes in the chromosomes, is subdivided into chapters dealing with these topics: deficiencies, duplication, inversions, interchanges, and *Oenothera* cytogenetics. In this area the author, through his own efforts and those of his students, is a major contributor. There is a careful weaving of information, from a varied group of organisms, that should aid in the interpretation of significant phenomena in each particular subject. Both sections are particularly useful for their elucidation of detailed methods of handling various chromosomal aberrations and for information derived from these. Relevant data and interpretive diagrams will help the breeder and geneticist who is confronted with such problems in his cultures. There is a great reliance on the experimental results derived from maize cytogenetics.

In the second section, on changes in chromosome number, the author includes chapters that survey the experimental procedures and results in the areas of aneuploidy, autopolyploidy, allopolyploidy, and the applications of polyploidy. Geneticists and plant breeders working with polyploids will be especially interested in these chapters, since the author has elaborated on topics such as "maximal equational segregation," an important aspect of autopolyploidy. Burnham suggests that, since there is so little difference between final theoretical ratios based on different types of segregation, there is a need for additional experimental support of dubious ratios in the form of an  $F_3$  generation. Clarification is also given the frequency term *alpha*.

There is an introductory chapter on linkage and chromosome behavior, and there are additional chapters on sex determination and apomixis. Also included is an appendix of suggested problems that should give students adequate opportunity to explore and utilize the book's contents. An extensive index is included and, in addition, approximately 1300 references are cited. A perusal of these references will acquaint one with the major and pioneer contributors to the field.

This book is recommended to all workers in the area of plant cytogenetics. It contains a thorough coverage of considerable cytogenetic information which the thoughtful and interpretive student will find useful in developing and projecting his own ideas in further experimentation.

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## Human Reproduction

**Science and the Safe Period.** A compendium of human reproduction. Carl G. Hartman. Williams and Wilkins, Baltimore, Md., 1962. xii + 294 pp. Illus. \$12.

The control of human reproduction is a matter of paramount importance to the interests of the human race. It is indeed timely to review the extensive literature about mammalian reproduction, with special reference to man, and to critically evaluate the application of our knowledge to this problem. The author, Carl Hartman, has devoted his entire professional life to the study of mammalian reproduction and his outstanding contributions have stimulated many scientists to interest themselves in this field; thus, he is superbly suited to write this classic volume.

The initial chapters provide background information concerning the physiology of human reproduction. The origin, growth, and development of the ovum and the spermatozoon and their transport into the fallopian tube are described. The comprehensive review of spermatogenesis, the seminal fluid, and normal and abnormal spermatozoa provide much information concerning the male factor in fertility. The normal role of the sex steroids in controlling cyclical changes in the reproductive organs are reviewed.

Ovulation holds the key to our present interest in the control of fertility in women. It is not surprising that the major part of this book is devoted to a discussion of ovulation and of our knowledge concerning its accurate timing. Hormonal studies, changes in the cytology of the vagina, the cervical mucus, and the endometrium, and clinical manifestations such as the basal body temperature changes and "mittelschmerz" are evaluated as criteria