

as long to be produced in print. Such delays are bound to diminish the scientific impact and value of the eventual publication, especially when it embraces a rapidly expanding field of enquiry, as here. Nevertheless, the problems discussed in this work are mostly still with us, though some are appreciably nearer solution.

Of the book's five sections, the first and longest is the one of most general interest. It surveys the nature of chromosome aberrations, their kinetics and the various theories of their formation. H. J. Evans provides a competent review of the essential background knowledge, concentrating on the present position of the target hypothesis and the possible nature of chromatid "gaps". Subsequent highlights include Atwood's detailed account of the theory of site limitation for interchange formation, and a very lively discussion of Revell's exchange hypothesis for the formation of chromatid aberrations, ably defended by the author. The next two sections concentrate on biochemical and biophysical aspects of the subject, including such topics as the difference between the effects of chemicals and radiations, and the extensive work on free radicals, reviewed by Conger. There are also some useful discussions by Taylor and others on chromosome structure and replication, as revealed by radioisotope and electron microscope studies, while Swanson leads a discussion on the nature of the chemical bonds involved in aberrations, the important role of protein being stressed.

Attention is next focussed on chromosome aberrations in man and other mammals, with contributions by Chu on dose relations for the induction of chromosome changes in human cells and by Yerganian on the chromosome cytology of medical anomalies. There have been considerable advances in this field since 1961 and one must look elsewhere for a really up-to-date account. This final section ends with Lindsley's survey of the genetic effects of chromosomal aberrations, in which he restricts himself to work with *Drosophila* sperm, and a brief summing-up by Auerbach.

This book does not make easy reading. Some parts of the discussions are rather confusing and obscure, making it difficult at times to elucidate the underlying thought processes. Taken as a whole, however, the work seems to recapture very well the flavour of this lively and provocative meeting, in which important new ideas were subjected to a thorough scrutiny by the experts.

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METHODOLOGY IN BASIC GENETICS. Ed. by Walter J. Burdette. Holden-Day, Inc., San Francisco. 1963. Pp. xii+484. 40s.

This most useful book is based on a symposium which appears to have been held during late 1961 or early 1962. It contains eighteen articles, each one by an author occupying a leading position in his field. Attention is directed to the analysis of chromosomes and genes by genetical and biochemical methods, and the book does not deal with nuclear cytology nor with biometrical or population genetics. The most surprising omission is the absence of anything on flowering plants. One would have expected some treatment of maize genetics, particularly of paramutation and "controlling elements", but perhaps no one could be found to attempt, at the present time, a definitive treatment of these exciting but complex and slippery genetic systems.

The book is divided into six sections with three appendices. The first

section, on mutation and recombination in bacteriophage, contains articles by Freese on mutagenesis in bacteriophage and Edgar on phage recombination. Freese gives a concise account of his approach to DNA base-pair identification through specific mutagenesis, and is the only contributor to deal with methodology at the down-to-earth level of detailed recipes. Edgar provides an excellent summary of general methods while avoiding getting involved in the tangled subject of the theory of recombination in phage.

The section on mutation and recombination in bacteria contains papers by Ryan, Lerman, Hartman and Hayes, the latter in collaboration with Jacob and Wollman. Ryan's article is a long and closely argued one, summarising most of the varied and ingenious experimental techniques which were employed in his laboratory during more than a decade. It exemplifies his very individual approach to the problems of bacterial mutagenesis, combining imagination and enthusiasm with mathematical rigour. One is more than ever conscious of the tragedy of his too-early death in 1963.

The quantitative interpretation of inactivation rates of transforming DNA, which is the subject of Lerman's paper, may seem rather recondite for a book of this nature, but Lerman's account is a clear and critical one, and the *in vitro* manipulation of genetic material is a field which will be increasingly cultivated. Hartman provides a valuable and comprehensive survey of the literature relevant to transduction. Hayes, Jacob and Wollman, on bacterial conjugation, had the advantage of writing about a subject which is very largely their personal creation, and they were thus able to produce a much more gripping narrative. The greater part of their review has been published several times already, but it is always a pleasure to read it again.

Under the heading of "Mutation and Recombination in Fungi" there are accounts of meiotic recombination and tetrad analysis by Emerson, of gene conversion by Roman and of mitotic recombination by Pritchard. Emerson's paper is thorough and systematic, and has an Appendix dealing with the conflicting data bearing on chromatid interference in *Drosophila*. Roman gives a factual summary of the conversion phenomenon, with a useful emphasis on yeast, an organism which often seems to be overlooked, while Pritchard has written a very readable account of mitotic analysis, leaving one with the feeling that here, at least, is a subject which is reasonably well understood.

In the following section, which deals with *Drosophila*, Muller and Oster contribute a long paper on mutational techniques with special reference to the use of complex chromosome rearrangements in special stocks. This review is especially welcome since much of the information contained in it was previously relatively inaccessible. Two other papers on "chromosome engineering" in *Drosophila* by Novitski and by Lindsley and Sandler appear as Appendices to the book. These three papers stand as a reminder that *Drosophila* is still in a class by itself for the precision and complexity of the manipulations which can be performed with its chromosomes. It seems indeed to be one organism in which the sophistication of the available techniques has outstripped the supply of obviously important problems to which they could be applied.

The article on pseudoalleles and recombination in *Drosophila* by Green is remarkable for its unshakable conservatism of outlook. To-day most geneticists, and all microbial geneticists, think of the gene as a unit of

function which is most appropriately defined as a region of non-complementation or, in other words, as a cistron. A gene so defined is commonly subdivisible by recombination at a large number of different points. The foundation for this modern view was laid by Green himself, and independently by E. B. Lewis, through their demonstrations at a considerable number of loci in *Drosophila* of crossing-over between non-complementing mutants. Yet Green's theoretical position remains as it was before his discovery was made. For him the gene is still the indivisible unit of transmission. He argues that it is a fallacy to consider separable but non-complementing mutants (pseudoalleles) as belonging to the same functional unit since such mutants are often slightly different phenotypically, a point which seems to me to be little more than a verbal quibble. It is, of course, perfectly in order to use "gene" in Green's sense, provided we know where we are, but this does not dispose of the cistron, a unit the significance of which Green seems perversely loth to recognise. Leaving aside these philosophical questions, Green's review is a most useful one, bringing together much scattered information on relationships between alleles.

Under the heading of gene-protein relationships Streisinger deals in a rather brief and formal way with bacteriophage-evoked proteins, while Yanofsky gives a more detailed review of genetic control of enzyme structure in fungi and bacteria. Yanofsky's paper is the only one in the book to seem seriously dated, largely, it should be added, as a result of his own extraordinary progress during the time since he wrote it.

The final section, on cytoplasmic inheritance, is perhaps the most interesting and provocative in the book. Jinks, on fungi, and Nanney, on protozoa, look at the subject from quite different angles. Jinks, through a systematic comparative treatment of practically all known examples of cytoplasmic inheritance in fungi, builds a strong case for the widespread existence of cytoplasmic elements analogous in many ways to nuclear genes in their formal genetic properties. Nanney, on the other hand, guided by the evidence as it relates to protozoa, is concerned to emphasise that some apparent examples of cytoplasmic self-determination are due to cytoplasmically induced changes in nuclear activity. These two views do not seem necessarily to be in conflict, even leaving aside the possibility that there may be fundamental differences between the authors' respective experimental organisms. One cannot by a formal genetic analysis infer the mechanisms through which cytoplasmic factors perpetuate themselves, and demonstrations of cytoplasmic inheritance, even when they show such suggestive features as infectivity and segregation, do not necessarily imply the presence of structural information in the cytoplasm equivalent to that carried in the nucleus by DNA. This is not to say that the cytoplasm may not in some cases contain autonomous genetic nucleic acid. This is certainly so, for example, for the CO_2 -sensitivity and maternal sex-ratio conditions in *Drosophila*, described by Poulson in an Appendix. In these cases it is clear that the cytoplasmic abnormalities are associated with microbial parasites.

The book is well bound and printed on excellent paper, and there are few obvious lapses in proof reading. Its price is so low, considering its 480 substantial pages, that one suspects either a revolution in the economics of American publishing or a subsidy from some source. Since it will be a valuable reference book for many years to come it should enjoy a large sale.

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