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

of ovulation. Although it is possible to demonstrate that ovulation has occurred and the approximate time of its occurrence, one has to conclude from Hartman's comprehensive review that it is impossible to pinpoint the exact time.

The author has reviewed more than 2000 articles concerned with mammalian reproduction, and he discusses the pertinent information. He has also selected informative illustrations to clarify his discussions—numerous charts help correlate the various ovulation criteria so that their clinical application will be more useful.

This book will find an important place in the library of every student of mammalian reproductive physiology.

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Image of a Scientist

The Scientific Life. Theodore Berland. Coward-McCann, New York, 1962. viii + 308 pp. $5.75.

This book describes the lives and times of nine active scientists in the United States. Written for the general public, the book is based on a week's observation of and conversations with each man, much of which was tape recorded and is quoted at length. The intent is to present an accurate picture of what scientists are like, what they do with their time, and why they do it, in the hope that their fellow citizens will have a better understanding and appreciation of them, and that more young people will be attracted to the life.

The author has succeeded very well in giving a picture of the intensity of the good scientist's involvement with his work and the singlemindedness with which he pursues it. He may, indeed, have succeeded almost too well for his second purpose, that of attracting students to science. The reader may find himself exhausted by the indicated intensity of scientific devotion.

While more on the early histories of these men would be not only of considerable interest but also useful in discussions of education, there is enough to show how they got started, and certainly there is much evidence that, once started on a research career, no other activity could give these men as much satisfaction.

Emphasis on the individuality of the creative process is always a helpful reminder in these times of team research. Even more important is the description of the teaching function and of the importance of the apprenticeship role for the student scientist. But apprenticeship roles can only be arranged when the ratio of students to teachers is not too large. There is no suggestion of how this can be managed with the increase in the numbers of students to be expected without apparently a correspondingly rapid increase in the number of teachers. This is admittedly beyond the scope of Berland's book, but it is highlighted by the importance these men place on the close association of teacher and student.

It is not appropriate for a reviewer to comment on the opinions expressed by the individual scientists represented, but it is appropriate to discuss the author's selection of scientists as representative of the group. Berland defends his selection with some persuasiveness. My complaint is that it does reflect the narrow public image of what science is when he might have helped to broaden this by a different selection. I refer to the balance of fields rather than to the individual scientists. The individuals had to be selected in part for their willingness to be interviewed and quoted so extensively. The author characterizes them as ". . . in one generation range [age 33–56], actively at work, still creative, and steeped not only in the affairs of their careers, but of our world. Each is a man of accomplishment, well known in the scientific community, and holds promise of accomplishing still more. By training, four are physicists [Willard Libby, Murray Gell-Mann, Charles Townes, and James Van Allen], three are physicians [Albert Sabin, Chester Southam, and Jeremiah Stamler], one is a physical chemist [Dean Wooldridge, now an engineer-executive], and one is a social scientist [Philip Hauser]. By practice, one was the head of a large corporation, two have had high government offices, three are part-time university administrators."

His selection, then, comprises five physical scientists, three physicians whom he classes as biologists but none of whom is a biologist, strictly speaking, and one social scientist who is a demographer. Physics and medical research are probably what most people think of as science, and it seems a pity that Berland did not make some effort to broaden that concept. He says rather disingenuously that his subjects had to be doing something that could be explained effectively, but surely there are scientists in such fields as genetics, evolutionary biology, and psychology, to mention only a few, whose work can be as easily explained as research in nuclear particles or the role of viruses in cancer.

Errors, typographical and otherwise, seem very minor, but certainly Otto Klineberg would be startled to see himself as Kleinberg.

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Compton Lectures

Biological Order. André Lwoff. Massachusetts Institute of Technology Press, Cambridge, 1962. x + 101 pp. Illus. $4.50.

André Lwoff addressed the Compton Lectures that he delivered at Massachusetts Institute of Technology in 1960 to "the young physicists and chemists, with a very specific goal, namely to interest them in biological problems." This meaty little book, which contains those lectures, gives every indication that he attained his goal, for it is engagingly written, although here and there the author lapses into a telegraphic style in perhaps some of the more difficult passages. Nevertheless, while assuming that his audience knew nothing about biology, Lwoff apparently also presupposed a high degree of sophistication in certain domains coupled with an equal degree of intellectual curiosity among his listeners.

In six chapters and a brief conclusion, he discusses life (unpretentiously defined "either as a *property*, or as a *manifestation*, or as a *state* of organisms"), the organism and the cell, and "the problem of Biological order posed in its generality." To encompass the task in so brief a volume (or time) obviously imposed a high order of selection. His discussion of hereditary order as the nature, structure, reproduction, and variation of the genetic material reflects his own richly productive contributions as a practising researcher, as do the succeeding chapters. Under the heading "Functional order," he considers the control of enzyme synthesis and heredity-environment interactions; then in "Viral function" that topic is considered as an example of specific order-disorder.