standards of deductive rigor that appeal to most phage workers. However, one might hope that in subsequent editions of this book Drake will bring his talent for crisp analysis and clear exposition to the difficult problems of mutagenesis and its control in eucaryotes.

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Blood Cell Formation

Regulation of Hematopoiesis. ALBERT S. GORDON, Ed. Appleton-Century-Crofts, New York, 1970. Vol. 1, Red Cell Production, xx pp. + pp. 1–766, illus., + index. $44. Vol. 2, White Cell and Platelet Production, xx pp. + pp. 767–1658, illus. $46. The set, $78.50.

These two volumes provide a comprehensive account of current views of hematopoiesis. The chapters vary considerably; some are excellent critical reviews, some are primarily reports emphasizing the authors' own work and views, a few are simply research papers, and a few are so brief that they are of little value. Even in these, the consultation of the literature cited would give pertinent up-to-date information. The references for the various chapters are uniform and complete. The physiology, morphology, chemistry, and clinical findings relevant to hematology are well correlated, and a concerted effort has been made to emphasize the subject as a general biological problem.

The range of hematological problems discussed is wide, and although the emphasis is on mammalian hematopoiesis, a brief discussion of the relatively neglected field of hematopoiesis in nonmammalian vertebrates, as well as an excellent review of insect hematopoiesis, is included.

Several chapters are devoted to the stem cell problem, using primarily data accumulated during the last few years by the spleen colony technique and the growth of bone marrow cells in soft agar. These papers, as well as the more theoretical papers by Hirschfeld and Hodgson, should be stimulating to all investigators interested in the current status of this fundamental hematological problem. The field is in such a state of flux, however, that some of the conclusions may warrant modification in the future. The full potential of these relatively simple yet highly reproducible techniques is only beginning to be realized and their use, together with already available mouse strains having gene mutations affecting specific stages of hematopoiesis (discussed in a chapter by Russell), will give greater insight into the processes regulating hematopoiesis, possibly at the molecular level.

A number of excellent chapters are devoted to the many problems of normal, fetal, and abnormal erythropoiesis. An excellent critique of the in vivo assay of erythropoietin using the plethoric mouse is provided. A similar evaluation of the in vitro assay of the hormone, frequently used in studies of mechanism of action of erythropoietin, would be of value. Some attention is given to erythropoietin physiology, with perhaps too much emphasis on the role of the renal erythropoietic factor in the genesis of erythropoietin. These chapters, read in conjunction with the recent book by Krantz and Jacobson (*Erythropoietin and the Regulation of Erythropoiesis*, University of Chicago Press, 1970), provide a balanced account of current knowledge of the erythroid system.

The second volume contains 25 chapters on the normal and abnormal morphology, physiology, chemistry, and kinetics of proliferation of the granulocytes, lymphocytes, monocytes, macrophages, and platelets. The overall coverage is as impressive as in the previous volume, and is well balanced.

Excellent chapters on the fine structure of blood cells are included. The chapter by Wetzel on granulocyte fine structure and his discussion of the technical and interpretative problems of electron microscopy should be read by all hematologists. Regrettably, many of the fine electron micrographs and photomicrographs have suffered a loss of detail during reproduction.

Any hematologist reading these volumes could point out topics that have not been covered, but certainly most of those that have been covered are presented comprehensively. A more thorough indexing of the work would have greatly increased its value.

The price of this work precludes individual purchase, but the volumes should be available in all laboratories interested in hematological problems. Biologists interested in differentiation and cellular interactions should also find this book of interest, since the hematopoietic system provides an excellent model for such studies.

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Chemistry and Entomology

Chemicals Controlling Insect Behavior. MORTON BEROZA, Ed. Academic Press, New York, 1970. xiv, 170 pp., illus. $10.

Control of Insect Behavior by Natural Products. DAVID L. WOOD, ROBERT M. SILVERSTEIN, and MINORU NAKAJIMA, Eds. Academic Press, New York, 1970. x, 346 pp., illus. $11.

These two volumes, containing contributions from 38 authors, including 15 from Japan, are largely complementary. Together they probably constitute the most complete and up-to-date reviews available of the various aspects of chemical control of insect behavior by pheromones and substances produced by host plants. As such they will be invaluable background reading and sources of reference for all those who are interested in the isolation, identification, synthesis, biological function, and possible practical use of such naturally occurring organic compounds.

It was an excellent idea for biologists and chemists who are currently working on these problems to consider together plant attractants and the various types of pheromones of both solitary and social insects, and to discuss many of the chemical, physiological, and ethological methods of studying them. The results are very rewarding.

The difficulties of the biologist in devising quick and reliable laboratory bioassay techniques that bear some relationships to natural field conditions are recognized, as are the extremely difficult problems of the chemist, even with the most sophisticated equipment, in isolating and identifying minute traces of biologically potent, and sometimes fugitive, compounds. These problems are well illustrated by the fact that even though more of the so-called "alarm" pheromones, which are not only present in relatively large amounts but are also fairly easily assayed biologically, have been identified than pheromones of any other group, they present biological difficulties in that, as no doubt happens with other pheromones, they elicit at small and great concentrations quite distinct but equally important responses from recipient insects. Furthermore, as work has proceeded during the last decade, the problems have been seen to be more, rather than less, complex than was first thought, as many pheromones are being found to be mixtures of several compounds, sometimes acting synergically. In other cases a series of stimuli are necessary. For instance, an insect that has found a potential mate, or

host plant, through the agency of a volatile sex pheromone, or plant odor, does not necessarily mate or feed. Further stimuli, presented in the correct sequence and in the right context, may be necessary before these end results are achieved. Just as aphrodisiacs and courtship behavior may be essential preliminaries to mating, so the texture of a leaf of a food plant and, perhaps, its degree of turgidity may determine whether an insect will feed.

The temptation to exaggerate the practical possibilities of controlling populations of insect pests by manipulating their systems of chemical communication has, by and large, been resisted by those contributing to these volumes. The results obtained so far, often at great expense, have been useful in making surveys but apparently not, with a few possible exceptions, in directly controlling pest insects. The potentialities are so great, however, that work on pheromones, plant attractants, arrestants, repellents, and other such substances should be intensified.

In the immediate future, insecticides will certainly continue to be our mainstay in combatting insect pests, but highly selective insect attractants and repellents will probably have important parts to play in the long-term goal of controlling insect populations effectively, economically, and without harming man or his environment. However, much more detailed information is required, and, as is indicated in these volumes, this can only be obtained by close cooperation between chemists and insect ethologists and physiologists.

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Calcium in Living Systems

Biological Calcification. Cellular and Molecular Aspects. HARALD SCHRAER, Ed. Appleton-Century-Crofts, New York, 1970. x, 462 pp., illus. $24.

Recent contributions to the understanding of biological calcification have come from several disciplines. The diversity of experimental approach and the variety of the material studied have often, and quite naturally, meant that information in one sector is not common knowledge in the field as a whole. The present volume will provide a welcome and useful extension of the lines of communication by bringing together viewpoints of several disciplines and findings on calcification in mammals, invertebrates, plants, and microorganisms. The focus, appropriately specific rather than broad, is on cellular and molecular mechanisms. Since the volume is less than 500 pages in length, some aspects of calcification inevitably receive only brief statement or are omitted altogether. This is apparently by design, for the objective is to provide perspective rather than a compendium. Even so, some will wish for a more complete discussion of such topics as mechanisms of invertebrate calcium deposition, bone formation, and hormonal factors in calcification. Those who are interested in plants and unicellular organisms will appreciate the substantial coverage of calcification in these groups.

The 13 investigators contributing to the volume have provided excellent summaries of research and current thinking on various aspects of calcification. These include the crystallography of bone, the composition and ultrastructure of skeletal structures, calcification of organic matrices, and the physiology of calcium movement. A valuable aspect of the discussions is the attention given to problems that require experimental study. The illustrations in the volume are of uniformly high quality and include a hundred pages of electron micrographs and photographs. The sections on unicellular organisms and plants by F. G. E. Pautard and H. J. Arnott are comprehensive in the inclusion of various aspects of mineral metabolism. I found the style and appreciation of historical perspective of these chapters delightful. R. and H. Schraer give an interesting account, with new data, of the remarkable system of calcification by the hen's shell gland. Nearly one-fourth of the volume is devoted to a chapter on representatives of four invertebrate phyla and bovine enamel, presenting in detail the ultrastructure studies of D. F. Travis and her associates.

It is evident from reading the various presentations that the study of calcification now requires an assessment. A comparison of the differences among various calcification systems as well as of the characteristics they have in common would be most valuable in increasing our understanding of calcification mechanisms.

The bibliographies in the volume are extensive, totaling some 1100 references. Unfortunately, few studies are cited for the two years preceding publication, a circumstance that undoubtedly rests not with the authors but with the extended period in bringing the volume to conclusion.

This book will be helpful as an introduction to specific phases of calcification, and its review of several areas of research provides a breadth of view of this diversified field of study.

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Cyclic Structures

The Chemistry of Inorganic Ring Systems. IONEL HAIDUC. Wiley-Interscience, New York, 1970. Part 1, viii pp. + pp. 1–622, illus.; part 2, vi pp. + pp. 623–1198, illus. Each part, $34.50. Monographs on Chemistry: Inorganic Chemistry Section.

The significant development of research on cyclic inorganic systems that has taken place in the last decade or two has been prompted by both theory and practice—by theory to the extent that the bonding and geometry originally restricted to carbon systems are now recognized as broadly applicable and capable of yielding substances with properties unlike those characteristic of carbon compounds, and by practice to the extent that the demand for new materials with specific properties has intensified investigation of new polymeric systems. Haiduc summarizes this development in an encyclopedic but readable and understandable fashion. His inclusion of an abundance of references to the original literature, many tabulations of numerical data, and thorough indexes provides the reader with a single, invaluable source for most of the information he may need.

The introductory chapter in volume 1 gives the necessary details of classification, nomenclature, molecular structure, bonding, and equilibria essential both to an understanding of inorganic ring systems and to a systematization among the several elements. The ring index in the latter part of volume 2 illustrates a continuity in nomenclature and a correlation with designations used in organic chemistry to describe heterocycles containing carbon atoms. The detailed treatment of particular inorganic ring systems is divided among an all-inclusive chapter on homocyclic systems, a series of extensive chapters treating heterocyclic systems by periodic group of the major element, and a chapter on metal-containing coordination