Book Reviews

Cardiac Contractility

The Physiological Basis of Starling's Law of the Heart. Proceedings of a symposium, London, Sept. 1973. Associated Scientific Publishers (Elsevier, Excerpta Medica, North-Holland), New York, 1974. x, 298 pp., illus. $15.40. Ciba Foundation Symposium 24 (new series).

This book provides new insight into the mechanisms underlying the physiological phenomenon described by Starling's law of the heart—that is, that the force of cardiac contraction increases as the heart fills. The articles and discussions contain new information that suggests that the sliding filament hypothesis formulated in 1966 in A. F. Huxley's laboratory may not be completely adequate to explain sarcomere length-tension curves. B. R. Jewell points out that the improved estimate for the length of the thin filament, 1.50 μm instead of 1.60 μm, means that the plateau of the length-tension curve should occur at sarcomere lengths of 1.9 to 2.15 μm, not at the lengths of 2.0 to 2.25 μm measured in 1966.

The finding reported by Taylor and Riidel, that at short sarcomere lengths muscle fibers are not properly activated, raises the possibility that the relation between sarcomere length and the efficiency of excitation-contraction coupling is one of the factors in determining the length-tension curve.

In addition to the articles, the book includes four excellent general discussions. The first is of cross bridges and the underlying basis of the length-tension curve. X-ray diffraction data and electron microscopy data with regard to formation of cross bridges are compared, and serious discrepancies are found between the length-tension curves of skeletal muscle and cardiac muscle. Skeletal muscle has a relatively broad plateau of peak tension between sarcomere lengths of 2.0 and 2.2 μm, in comparison to cardiac muscle, which develops a peak tension at a sarcomere length of 2.2 μm. In cardiac muscle, tension drops off sharply on either side of the peak length, as opposed to the shallow decrease in tension on either side of the plateau observed in skeletal muscle. The second and third discussions concern force-velocity relations and sarcomere lengths of cardiac muscle. The final discussion is of particular interest, since it concerns the consequences of stretch and shape changes on radial diffusion of oxygen, ions, resting metabolism, and excitation-contraction coupling. The possibility is raised that the increase in cardiac tension as a function of stretch may be related to an increase in efficiency of excitation-contraction coupling as well as to the number and quality of cross bridges formed.

The 14 articles in the book are uniformly good and make an excellent contribution to our knowledge about cardiac muscle. The book should be very valuable to cardiac physiologists and cardiologists.

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Reproductive Process

Fertilization in Higher Plants. Proceedings of a symposium, Nijmegen, Netherlands, Aug. 1974. H. F. LINSKENS, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1974. xiv, 374 pp., illus. $26.95.

As the editor and many of its contributors remind us, man's use of plants for food depends heavily on the process covered by this volume. It is well to be reminded, also, now that somatic cell genetics is being perhaps oversold as the plant-breeding technology of the future, that this is the way plants do it when left, more or less, to their own devices.

There is much to be learned from the 43 papers, some of it discouraging. One wonders, for instance, why much of the work from the Soviet Union seems barely to have left the 19th century, and whether that fact has any relationship to the sorry state of agriculture there. Fortunately, the condition does not obtain in Eastern Europe generally. One of the most technically advanced presentations is that of Erdelská based on microcinematography within the embryo sac of *Galanthus*. Again, one can hardly describe as old-fashioned the investigation by Ryczkowski on oxygen tension and respiration with the *Haemanthus* ovule, although the data presented may well be beyond the limits of the techniques used.

Among the pollen studies, two solid contributions by Pfahler on *Zea* genotypes in fertilization are noteworthy, as is the short, thought-provoking article by Mulcahy on the adaptive significance of gametic competition in plants. Vasil provides an illuminating and scholarly review of the histology and physiology of pollen-stigma relationships. Some elegant light microscopy by Wilms documents the branching of *Spinacia* pollen tubes, which is probably a postfertilization phenomenon.

In the physiological domain, perhaps the most impressive paper is that of Linskens, demonstrating and graphically summarizing the different patterns of radioactive sugar and amino acid translocation with *Petunia* flowers following compatible (cross-pollinated) and incompatible (self) fertilization. The absence from the paper of precisely comparable graphs for nonpollinated material is pedagogically regrettable, though not a serious flaw.

Although one would be happy to discover, through such a symposium, that major advances, advances with great fundamental and practical significance, are being made, to say that about this volume would be to exaggerate. But when such advances do occur, they will be built on the foundations established by research and meetings of this kind.

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Nitrogen and Plants

The Biology of Nitrogen Fixation. A. QUISPEL, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1974. x, 770 pp., illus. $63.50. Frontiers of Biology, vol. 33.

This book is a comprehensive treatment of the biological aspects of dinitrogen fixation, and as such it is well done. It covers not only the well-known aspects of N_2 fixation but many of the as yet unglamorized aspects, such as the N_2 fixation that occurs on plant leaves (phyllosphere) and in the area surrounding plant roots (rhizosphere). From reading this book the more biochemically or chemically oriented researchers in the field can gain detailed information on (or find references to) practically all those biological aspects

of N_2 fixation that have been researched. I found the chapters on the N_2-fixing organisms most interesting. One never ceases to be amazed at the various ways in which different biological agents have "solved" the problem of growing in environments where fixed nitrogen is in short supply, and each chapter in this section discusses in detail a different N_2-fixing mechanism.

Particularly helpful to those who wish to enter the field is a chapter on methodology. This chapter not only describes the various methods that can be or are being used to measure and detect dinitrogen fixation, but also presents in an easily followed style many helpful hints and techniques that can save researchers many hours of trial and error. These are clues and pieces of information that tend to be omitted from more formal articles, and without them experiments are difficult to repeat. As an example, the types of tubing or plastics that can be used to hold the biological agent when measuring N_2 fixation are described with respect to their permeability to gases. Such information is extremely valuable, especially if one is using a particularly O_2-sensitive organism.

The chapters dealing with the *Rhizobium*-root-nodule systems, covering such topics as the infection process, morphogenesis, bacteroid formation, leghemoglobin, and ecological requirements, are well done. There is hardly an aspect that has not been covered; the authors not only have done their homework well but have presented the material in an effective way. The comments concerning root nodules also apply to the chapters on blue-green algae in which the requirements to support N_2 fixation are well documented and the fascinating subject of the development of heterocysts is thoroughly discussed. Topics that particularly interested me (possibly because I am less familiar with them) are found in the chapter concerning the associations of blue-green algae with plants such as liverworts, mosses, and ferns and the role of actinomycete-like organisms in root-nodule N_2 fixation.

The chapter on nitrogenase (the enzyme system) presents a good review of the requirements for the various N_2-fixing systems. It is not as detailed and informative as the other chapters, but it need not be, since these topics have all been reviewed extensively elsewhere. The chapter on genetics will be of interest to everyone studying N_2 fixation because it describes the beginnings of what will be a most important field of research that will eventually tell us whether or not we can put the *nif* genes into non-N_2 fixers and make them N_2 fixers.

The only major fault I can find with the book is its price.

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New Uses for Lasers

Chemical and Biochemical Applications of Lasers. Vol. 1. C. BRADLEY MOORE, Ed. Academic Press, New York, 1974. xii, 398 pp., illus. $29.50.

This collection of articles by chemists who have been working with lasers for many years reviews a number of significant applications of lasers in chemical research. The emphasis is on those fundamentally new measurements and experiments that can be achieved by the application of laser sources to chemical problems. The editor intends to present material suitable for the expert as well as the scientist unfamiliar with the subject, and the contributors have for the most part succeeded in doing that. Chapter 1 is devoted to an introductory survey of available lasers, the way that they work, and their special properties as tools for research. In addition, each of the other ten chapters includes an overview of its subject for the nonexpert. Many of the original experimental laser techniques are described with comments on their limitations and capabilities.

For photobiologists and biochemists the book offers chapters on Raman spectra of biological molecules, kinetic studies of rapid solution reactions by the laser temperature jump method, and laser studies of rapid reactions in photosynthesis and vision. Some of the most elegant work done on biological systems is accomplished with picosecond pulsed-laser technology. The variety of laser techniques described may provide powerful ways to probe the structural and kinetic details of living systems.

The dynamics, chemical reactions, and energy transfer of laser-excited molecules are considered as applied to both molecular beams and bulk gas phase processes. The laser is capable of stimulating a number of unusual and selective chemical reactions. Such results provide strong motivation for a more detailed understanding of intra- and intermolecular energy transfer, internal conversion of electronic excitation, intersystem crossing, and predissociation. These subjects are discussed with many examples. It is shown how laser photodetachment studies of negative ions lead to the first reliable determinations of an important thermodynamic property, electron affinities. Optical analogs of pulsed magnetic resonance phenomena provide a new approach to using the coherence of laser sources to probe relaxation and orientation effects of excited states.

Many of the contributors include speculations about future work. It is evident that much of the laser research discussed is still in its infancy, but the book leaves no doubt that lasers have already made tremendous contributions in the study of chemistry.

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Pest Control Chemistry

Organophosphorus Pesticides. Organic and Biological Chemistry. MORIFUSA ETO. CRC Press (Chemical Rubber Co.), Cleveland, 1974. xii, 388 pp., illus. $44.95.

Phosphorus esters have been found to be biologically active not only as insecticides but as acaricides, fungicides, herbicides, nematicides, rodenticides, plant growth regulators, synergists, and insect sterilants. Their importance is related to their high activity and their variety in biological action as well as to their short persistence in the environment. The chemistry and biochemistry, both pure and applied, of these pesticides are of interest to the biologist, the toxicologist, and the environmental scientist, as well as to the synthetic organic chemist.

The first three chapters of this book deal with nomenclature, basic phosphorus chemistry, synthesis, important chemical reactions, and phosphate ester analysis. This section is well organized and expertly and lucidly written. Chapter 4 deals with the biochemistry and metabolism of organophosphorus compounds and with the mode of action, selective toxicity and resistance, interaction with other chemicals, and side effects of organophosphorus insecticides. This chapter is also well organized, but the biochemistry of resistance is only casually reviewed. Chapter 5 is a résumé of important information concerning the