Photobiology: A Splinter Discipline That Crosses Departmental Lines

Photophysiology. vols. 1 and 2. vol. 1, *General Principles: Action of Light on Plants* (xiv + 377 pp. $14); vol. 2, *Action of Light on Animals and Microorganisms: Photobiochemical Mechanisms; Bioluminescence* (xiv + 441 pp. $15). Arthur C. Giese, Ed. Academic Press, New York, 1964. Illus.

The content of biology, like living matter itself, continues to evolve. The equisetums and coelacanths vie with cultured cells, homogenates, and enzymes for elbow room on the investigative stage, and the herbarium sheet and microtome compete with chromatographic paper and amino acid analyzer for laboratory space. Change and a regrouping of forces is, of course, inevitable and constant, but whether these are synonymous with progress or with retrogression depends upon the assessor. The elements of conservatism are most clearly seen in curricular stagnation; lack of innovation in university departments and in entrenched personnel; societies and journals which, with Welwitschian stubbornness, still cling to life; and the unwieldiness of large national and international congresses. Dynamism, on the other hand, finds its public expression in splinter groups operating outside the framework of traditional societies, in an occasional department or institute created around a frontier subject, and an occasional publishing house, such as Academic Press, willing to gamble on the future, and in doing so, to lead. In the immediate past and the now turbulent present, biochemistry and genetics have contributed most significantly to this dynamism, and both disciplines have had an influence that extends well beyond their confines. In fact, so significant has been their influence that both stand in danger of losing their identity and becoming ways of life for the biologist rather than remaining as specific and well-defined subdisciplines.

Photobiology gives evidence of joining this select disciplinary group, and of exerting a comparable influence. In an evolutionary sense it is an old science, but today, perhaps through outcrossing to physics and chemistry, it possesses the vigor of an aggressive weed. Photobiology cannot be called a discipline in the conventional sense, nor is it likely to become one. It has no circumscribed frames of reference other than a physical parameter set by the wavelengths of ultraviolet (UV), visible, and infrared light and a biological parameter determined by the varied responses of organisms elicited by the photochemical interaction of light with living matter. No university or research group can yet be identified as a center for photobiology, for its subject matter transgresses departmental lines; it is neither botanical or zoological, nor is it chemical, physical, or biological. No special techniques other than spectroscopy dominate the field, and no group of organisms is excluded because of an unresponsiveness to light. As a result, no subdivision of the biological sciences can ignore photobiology in the sense that light is one of the most important environmental variables. The problems amenable to a photobiological approach are many and varied, so much so that few investigators, including myself, are fully conversant with its innumerable facets. Yet within this diversity there is a dynamic unity, and the present two volumes are eloquent evidence of this fact.

Arthur Giese, as editor, has chosen to call the field photophysiology. One cannot seriously quarrel with him on this score, although the broader designation of photobiology seems preferable since many of the photoresponses of organisms are known only in a behavioral rather than a physiologically meaningful sense. Be that as it may, a real service has been performed by assembling, in review form, the pertinent facts and discoveries of photobiology, many of them of recent vintage. No significant topic has been slighted or omitted.

Volume 1 covers the general principles and techniques of physics and chemistry encountered in photobiological studies—photochemistry, electron spin resonance and spectrophotometry, the determination and interpretation of absorption and action spectra, and the application of these technical facets to problems peculiar to photobiology. Stig Claesson, M. S. Blois and E. C. Weaver, A. D. McLaren, and Mary Belle Allen have authored these chapters. The remaining chapters in this volume deal with the action of light on plants: the chemistry and biophysics of photosynthesis; the role of accessory pigments in photosynthesis; the effect of light on chloroplasts and protoplasm, including streaming; phototropism; the chemistry of photoperiodism; and the role of light in governing daily rhythms. F. R. Whatley and M. Losada, R. K. Clayton, L. R. Blinks, W. R. Briggs, H. I. Virgin, S. B. Hendricks, and J. W. Hastings are the contributors.

Volume 2 covers a miscellany of topics, related only in the sense that some portion of the electromagnetic spectrum is implicated in a biological response. Included are animal photoperiodism, phototaxis in microorganisms, three chapters on vision and photoreception, action of UV on animal cells, mutagenic effects of UV and visible light, photoreactivation following UV exposure, photochemistry of nucleic acids, and bioluminescence. As is true for volume 1, the authors of the chapters in volume 2 are distinguished practitioners in their respective fields: A. Wolfson, R. K. Clayton, D. Kennedy, W. A. H. Rushton, H. B. Barlow, A. C. Giese, G. Zetterberg, C. S. Rupert, K. C. Smith, and A. M. Chase.

Both volumes convey the sense of accomplishment that has marked the progress of photobiology during the past decade—the advances made in our understanding of photosynthesis; the implications of photochemistry to biological phenomena; the discovery and characterization of phytochrome; the resurgence of vision physiology; discovery of photoreactivation and the enzyme controlling its expression; the elucidation of UV inactivation of cells through thymine dimerization and its reversal by visible light; and the clarification of the role of light in rhythmic and behavioral events. It is not within

my competence to comment critically on each of the contributions; the total effect of the two volumes, however, is impressive, and Giese and his collaborators are to be congratulated for a piece of work that cannot help but give focus and impetus to an expanding and significant field of scientific endeavor.

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Propellants for Rockets

Theoretical Evaluation of Chemical Propellants. Roger Lawrence Wilkins. Prentice-Hall, Englewood Cliffs, N.J., 1963. xvi + 463 pp. Illus. $15.

Wilkins has endeavored to make the five chapters and four appendices in his book a complete treatise for those who wish to evaluate the performance of chemical propellants in rockets. The author's own experience has made him aware of the great difficulty involved in obtaining or finding exact values for the thermodynamic quantities needed, and he uses the first four chapters to outline in some detail the methods one can use to arrive at good estimates of these values, when they have not been experimentally determined. The fifth chapter is a sound discussion of several methods used to arrive at an evaluation of the potential performance of chemical propellant combinations. Wilkins has been particularly careful to give adequate references for all data used in his discussions.

In the first chapter, "Calculations of thermodynamic functions of ideal gases," the author discusses several methods of calculating thermodynamic properties in the ideal gas state from molecular structure data derived from spectroscopic studies. In chapter 2, "Calculation of thermodynamic functions of solids and liquids," he deals with the problem of calculating thermodynamic properties of liquids and solids from limited spectroscopic data, and in chapter 3, "Theoretical methods for estimating standard heats of formation," he summarizes data available on heats of formation of compounds and discusses several reliable methods for making estimations when experimental data are lacking. In chapter 4, "Calculation of chemical equilibrium in complex systems," Wilkins shows how the data derived in the first three chapters are used to calculate equilibrium constants for individual chemical species. These constants can be used to calculate chemical equilibria, and the methods can be applied to a system that contains gaseous and condensed phases. In chapter 5, "Performance of chemical propellants for rocket engines," he shows how the methods developed in the previous chapters can be used to estimate the performance of chemical propellants. Typical results on a large number of chemical systems are also given in chapter 5.

The appendices are entitled "Thermodynamic functions of a monochromatic oscillator, with additional functions required for anharmonic corrections"; "Thermodynamic functions of some atomic species in the ideal gas state"; "Thermodynamic functions of some diatomic species in the ideal gas state"; and "Thermodynamic functions of some polyatomic species in the ideal gas state."

Overall, Wilkins has achieved his goal of providing a sound discussion of the thermodynamic methods involved in calculating propellant performance. The use of data at chamber pressures of 500 psia (pounds per square inch absolute) and 1000 psia is perhaps good. This should indicate to the newcomer that, although standard performance is quoted for chamber pressures of 1000 psia, actual usage will generally give a lower value.

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Atmospheric Research

Radio Astronomical and Satellite Studies of the Atmosphere. Jules Aarons, Ed. North-Holland, Amsterdam; Interscience (Wiley), New York, 1963. viii + 561 pp. Illus. $17.50.

This book includes the 28 papers presented at the summer school of the Advanced Study Institute at Corfu, Greece, in June 1962. The institute is one of a series of such meetings for specialists, held under the sponsorship of the Scientific Affairs Division of the North Atlantic Treaty Organization. The book title appropriately describes the major techniques utilized in the studies presented. The studies deal with the following topics: structure and composition of the atmosphere (a review), radio star scintillations, radar astronomical studies, cosmic noise absorption, satellite studies of the atmosphere by radio techniques, planetary atmospheres and incoherent scatter, and solar-terrestrial relationships.

Roughly one-half of the papers comprise reviews of relevant fields, with extensive bibliographies. Several of these are particularly valuable in view of the current status of research in the fields—for example, the reviews of techniques that utilize satellite radio transmissions for studying the earth's upper atmosphere. Such studies appear to have reached the stage where first order results are well in hand, and the reviews should be helpful in preparing for second generation experiments. Similar statements can be made about several other areas covered in the book.

In view of the above, I recommend this book as reading for specialists in the areas that it covers. The editor is to be commended for including, in the introduction, a summarization of the study groups recommendations with respect to the directions in which such researches should be pursued in the future. In fact, expanding that portion would have made the book even more valuable.

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Ecology

Quantitative Plant Ecology. P. Greig-Smith, Butterworth, Washington, D.C., ed. 2, 1964. xii + 256 pp. Illus. $8.95.

The first edition of this book (published in 1957) brought together leading concepts and thinking in quantitative approaches to plant ecology, by its clearly written and critical evaluation. The book has become the primary reference guide in this field of research and the most useful introduction to these problems for students in all aspects of community ecology. The second edition, which retain virtually all the material of the first, includes pertinent literature through 1962. By far the largest proportion of literature used is by British authors, entirely in keeping with the productivity of that group in quantitative studies, but an increased number of references to papers by workers in other countries indicates