thetic tissues in light, and the role of various environmental factors on net photosynthesis. Each subject is examined in a scholarly manner, and work published through 1967 is covered.

Physiological and biochemical interpretations of the mechanisms of the processes discussed are avoided. Thus, although Heath is a world leader in research on stomatal movement and CO_2 enters leaves through stomatal pores, he provides no information about how guard cells carry out this essential function.

Both sides of controversial questions are presented fairly. However, portions of the book dealing with photorespiration (the process by which certain species evolve CO_2 in the light) might be misleading to someone encountering this subject for the first time. It is stated (p. 139) that there is relatively little difference in photosynthetic efficiency (CO_2 uptake per unit of leaf area) between herbaceous species, although it is now well established that species may differ in efficiency by at least two- to threefold. Much of these differences can be explained by variation in photorespiration, as evidenced by direct and indirect measurements. Nevertheless, the author believes (p. 173) that it is "problematical" whether photorespiration occurs at high rates in an atmosphere containing 300 parts of CO_2 per million (normal air). Decker, in 1959, had already shown that the post-illumination burst, a measure of photorespiration which like all other methods underestimates it, is the same at the CO_2 compensation point (45 ppm) as at 300 ppm and that photorespiration greatly exceeds dark respiration in many species.

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Plant Science Chronicle

A Short History of Botany in the United States. JOSEPH EWAN, Ed. Hafner, New York, 1969. x, 174 pp. $7.50.

In his preface to this book, the president of the XI International Botanical Congress, K. V. Thimann, makes a significant statement that "there is, of course, no 'American Botany.'" But the occurrence of the congress in Seattle in August 1969 provided an opportunity for a number of American botanists to summarize the events in their respective fields of plant science.

Joseph Ewan, who undertook to edit this work, presents at the beginning a chronology of events pertaining to botany, starting in 300 B.C. He admits that this chronology is subjective, but the summary is so fascinating to read that it is easy to ignore the incompleteness in some areas and the triviality of some of the events listed in others.

In this book the science of botany has been divided into the "traditional" areas. This organization works for the earlier history of the subject, but obviously there are problems as one approaches the present, with considerable interdigitating of fields. For example, "pteridology" cannot be considered completely separate from "plant genetics and cytology," because a great deal of contemporary work on ferns involves the cytological approach. Similarly, experimental plant morphology gets short shrift because it is neither completely physiological nor completely morphological. There had to be some kind of separation of topics, however, and any scheme would have had a certain degree of arbitrariness about it.

Naturally, a book of essays by different authors results in a degree of unevenness. Some essays here, such as the contribution of Sterling Hendricks on "Plant physiology" and that of E. D. Rudolph on "Bryology and lichenology," are well organized and trace the development of their subject by periods. Others (examples are "Morphology and anatomy" by Sherwin Carlquist and "Taxonomy" by Charles Heiser) are more informal and less tightly organized. On the whole, Ewan did an excellent job in making his selections; my principal complaint is that many of the authors are among the giants in their fields and that a collective sense of modesty among them must have been responsible for omission of some of their own important contributions in recent years.

In spite of the announcement (which appears more than once in the book) that there is no such thing as an American Botany, the book tends to be principally a chronicling of events that occurred in this country, and as a result it becomes a little sterile, failing to give a clear picture of the development of the science as a whole. And this development cannot be outlined without reference to the persistent and continuous interaction of botany in the United States with that in other parts of the world. There have been more transfusions since the initial impetus in each of the fields of botany, and the thread in the story of the growth of American Botany is not confined to the northern part of the Western Hemisphere.

Nevertheless, the book serves a useful function in allowing us to step back for a moment, to look at what has been done locally, to determine what trends have developed, and to try to decide where we should go now. We have all profited from the occasion of the XI International Botanical Congress, the enthusiasm and energy of Joseph Ewan, and the thoughtful essays of the authors.

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Phagocytes

The Macrophage. NANCY N. PEARSALL and RUSSELL S. WEISER. Lea and Febiger, Philadelphia, 1970. x, 206 pp. $8.50.

Although mononuclear phagocytes were once considered to act wholly as scavengers, they are now believed by many to be capable of a wide variety of functions, particularly in immune mechanisms. Rightly or wrongly, some role has been ascribed to these cells in virtually every aspect of the immune response. Pearsall and Weiser, who are active contributors to this field, have provided us with a highly readable review of the widely scattered recent literature on this subject and have interjected their own thoughts concerning the significance of some of the data. Their stated object is twofold: to consolidate the information in order to provide a comprehensive characterization of the macrophages for those who are unfamiliar with the field, and to review some of the more recent work concerning these cells for those who are already familiar with it.

The result is a concise but comprehensive account which deals not only with the possible roles of macrophages in the formation of antibody and in cell-mediated immunity but also with the structure, origin, and metabolism of these cells. Current evidence concerning the ontogenetic and functional relationships of macrophages and other cells is also discussed. Such diverse topics as the synthesis of interferon and the inactivation of thromboplastin

by macrophages, as well as the possible contributions of these cells to the pathogenesis of disease states, are included. Some emphasis is given to an evaluation of the role of cytophilic antibodies in cell-mediated immunity.

As might be expected, such an extensive coverage in 151 pages of text results in some thin spots; however, 699 references to further reading are provided in the bibliography. In certain instances accuracy seems to have been sacrificed for the sake of brevity. For example, on page 102 the following statement appears: "It is known that nonsensitive cells are recruited to participate in delayed reactions because animals depleted of lymphocytes, by X-irradiation or other means, do not accept passive transfer of delayed sensitivity." This statement is somewhat misleading in its implication that the lymphocytes of the host are the critical participants in such reactions, an unproven point. In addition, the statement is not wholly true, because many procedures, x-irradiation in particular, which effect the depletion of lymphocytes also injure or destroy other cells, including the precursors of monocytes. Where the depletion of host lymphocytes is selective, the adoptive transfer of delayed hypersensitivity has in fact been demonstrated.

Investigators in any field which deals with macrophages will find this monograph a useful source book. Those who are not wholly acquainted with the work or views developed in Weiser's laboratory will find much to interest them.

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Optical Theory

An Introduction to Hamiltonian Optics. H. A. BUCHDAHL. Cambridge University Press, New York, 1970. xvi, 360 pp. $18.50. Cambridge Monographs in Physics.

Some years ago a young man applied to a large U.S. optical firm for a job as a lens designer. He apologized for lack of training, but on announcing that he owned two copies of the classic Conrady *Applied Optics and Optical Design*, one for his office and a second for his bedside table, he was hired on the spot. Perhaps the story will be repeated some day with Buchdahl's *Introduction to Hamiltonian Optics* as a similar credential.

Hamiltonian theory describes with powerful generality the overall properties of optical systems considered as "black boxes," although it does not describe the detailed structure needed to construct the systems that achieve these properties. Buchdahl's book is therefore on the subject of geometrical optics, but it is not about how to design lenses. It is, however, a compact comprehensive account of the fundamentals of the theory written with the lens designer's needs very much in mind. Every lens designer worth his salt has at some time in his career attempted to apply the broad concepts of Hamiltonian optics to the solution of practical problems. Success has been sufficiently rare that the theory, as such, has made little direct contribution to techniques for optical instrument design. The failures have been frustrating because of the obvious fundamental power of the theory and because of its conceptual elegance. The indirect effects have been large, however, both in contributing to an understanding of fundamental principles that govern the overall behavior of optical systems and in pointing the way to other, more practical, theoretical approaches.

Buchdahl approaches the subject not only as a capable mathematical physicist, but as one who with a knowledge of practical optics has made significant contributions to geometrical optical theory. Buchdahl's approach to higher-order aberration theory has over the last decade had a major impact on modern lens design with computers. Thus he brings to this exposition of Hamiltonian optics a familiarity with practical optics not usually found in authors on this subject.

The author claims his book to be nonmathematical, and indeed it might be so viewed by a professional mathematician. From the point of view of many physicists and engineers, it will appear to be quite mathematical. Moreover, this is a tightly written book. The subject matter is developed with precision, and the author expects the reader, at every point, to be master of the preceding exposition. It is thus a book for the scholar, or at least the serious student, and not a book for easy browsing. Problems are included at the end of each chapter. Many readers will be grateful that the author has provided solutions at the end of the book.

Buchdahl has filled a significant gap in the literature with this fine, well-constructed work. It will provide a basis for an understanding of optics by theoretical-minded students, and for an understanding of important optical fundamentals by the engineer. Perhaps it will provide the stimulus that will bring some fresh mind to find a way in which fundamental Hamiltonian theory can be actually used in the solution of actual optical design problems.

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Emissions from the Sun

Introduction to the Solar Wind. JOHN C. BRANDT. Freeman, San Francisco, 1970. xiv, 202 pp., illus. $10. Astronomy and Astrophysics Series.

Nearly a decade has now passed since the first systematic *in situ* observations of the solar wind were made by a spacecraft. Earlier observational evidence for the ejection of charged particles from the sun had been indirect, consisting principally of studies of comet tail orientations and geomagnetic activity. As early as 1958 it had been argued on theoretical grounds that the sun's million-degree corona must expand continuously into space with supersonic velocities near the earth's orbit. But the subject remained in controversy until 1962, when observations from Mariner 2 indicated a plasma outflow from the sun with velocities of the order of 400 kilometers per second and a mean particle density of about 10 per cubic centimeter at the orbit of earth.

The rapid development of solar wind physics during the past decade has been fraught with confusion and frequent misconceptions. Nevertheless, it has been a stimulating period marked with heated controversies, competing theories, imaginative ideas, and new experimental techniques. Unfortunately for the layman or the serious student of solar system astrophysics, much of this excitement is apt to fade when he is faced with tediously searching out the many technical articles on the subject scattered widely throughout the astrophysical and geophysical literature. To be sure, there are many excellent review articles on different aspects of the solar wind, but no single one of these presents a unified picture of the field as a whole.