

those mentioned, if only for brief mention, is desirable. Certainly with the short but carefully selected bibliography, a student should have no difficulty in supplementing the information which he is able to obtain from this book.

It is a pleasure to pick up a new book, and an American one at that, which uses an old and familiar classification, and justifies so doing. Rhodophyceae and Phaeophyceae still serve, in place of the newer but less euphonious Rhodophyta and Phaeophyta, while few will regret that the author has not found it necessary to use the term Tracheophyta.

There are more than three hundred illustrations, of which about two-thirds are original. These illustrations, as a whole, are of high quality and form a valuable part of the book. The photographic illustrations are particularly clear.

Any reviewer might glance through Prof. Haupt's book and discover features which he did not like or on which he felt he might improve. Nor would it be difficult to direct attention to errors and to statements capable of misconstruction. To do so would be less than fair to the author. By modern standards, he has undertaken a big task and one which might have been farmed out among specialists; but in that way the book would not have achieved an individuality, and that it undoubtedly possesses. F. W. JANE

## PHYSIOLOGY OF THE ALGAE

### The Metabolism of Algae

By Dr. G. E. Fogg. (Methuen's Monographs on Biological Subjects.) Pp. x+149. (London: Methuen and Co., Ltd.; New York: John Wiley and Sons, Inc., 1953.) 8s. 6d. net.

THE extreme diversity among the algae has presented a compelling challenge to the development of classical phycology based primarily upon studies of morphology, life-history, taxonomy and ecology. A few algae have been selected for the physiological study of cellular processes such as photosynthesis and various aspects of membrane phenomena. Yet there have been few attempts to seek out and define those general or comparative aspects of physiology which characterize the group. The only two reviews of the subject, by L. R. Blinks<sup>1</sup> and J. Myers<sup>2</sup>, did not appear until 1951 and were so limited in the field covered and divergent in point of view that they showed very little overlap. It is timely and appropriate that a more complete treatment of metabolism, the central core of algal physiology, should come from Dr. G. E. Fogg, an active member of a vigorously contributing group in University College, London.

The introductory chapter presents an abridged classification of algae and a classification of nutritional types which provides the basis of organization of the following chapters. Photosynthesis is presented as a necessarily brief survey of a large body of information. The attempt is directed toward exposition of the essential features of the process and the variations in terms of pigment participation and hydrogen donors observed among the algae. A chapter on chemotrophic assimilation provides a more complete synthesis of scattered observations and considers the spectrum of relationships between photosynthetic and oxidative assimilation of carbon. The topic of nitrogen assimilation includes consideration of nitrogen fixation in the blue-green algae and ammonia

and nitrate assimilation as observed principally in *Chlorella*. Amino-acid requirements now known for species of *Euglena* and *Chlamydomonas* are treated separately in a short chapter, together with the few known cases of vitamin requirements, under the title of heterotrophic assimilation. The carbohydrate, lipid and nitrogenous cell constituents are considered both as products of metabolism and as distinguishing biochemical characteristics of the various algal classes. A chapter on growth and metabolism is concerned with their inter-relationships. The thesis is set forth that, as a result of minimal excretion and versatile metabolism, changes in environmental conditions may give rise to a great range of variability in cellular composition in the simpler algae. A final four-page summary chapter presents the necessary apology for the limited sampling of algae on which generalizations must be based and reiterates some of the salient ideas of previous chapters in justification of algal metabolism as a distinct field of study.

Since the book will have impact upon future treatments of the subject, criticism should be made of the nutritional nomenclature upon which it is organized. The 1946 Cold Spring Harbor Symposium on Quantitative Biology proposed an elegant and precise classification of nutritional types of microorganisms<sup>3</sup>. The nomenclature was later applied to the protozoa by A. Lwoff<sup>4</sup> and now is applied to the algae by Dr. Fogg. Thus algae may be classified as phototrophs or as chemotrophs, depending upon whether the chief energy source is provided by photochemical or chemical reactions. Subclasses of photo- or chemo-lithotrophs or photo- or chemo-organotrophs are distinguished by their requirement for inorganic or organic exogenous substances. The classical terms 'autotrophy' and 'heterotrophy' are relegated to what is now a minor distinction based upon ability to synthesize essential metabolites. However precise the classification and however logical it may have appeared in 1946, there are now arguments against its continued use. It is cumbersome in terminology. It has had only limited acceptance in the field of microbiology for which it was designed. It does not necessarily group together organisms most closely related metabolically, and its separation into different groups implies far more profound differences than actually may occur. For purposes of discussion of metabolism of the algae, the classification is not a necessity, and at several points it leads to awkwardness of organization. Question is raised as to the desirability of its continued use.

The book is broader in its scope than a review. At the same time, its small size precludes the detailed treatment of data and the criticism and speculation which might be expected of a more exhaustive treatise. It is not directed toward the specialist in the field. It will orient but will not critically instruct the student who desires to work in the field. It serves well the stated purpose of bringing together the scattered literature "into a general account of the subject which will be of interest to students of botany, microbiology, and biochemistry".

J. MYERS

<sup>1</sup> Blinks, L. R., "Physiology and Biochemistry of the Algae", 263-291; in "Manual of Phycology", ed. by G. M. Smith, chap. 14. (Waltham, Mass.: Chronica Botanica Co., 1951.)

<sup>2</sup> Myers, J., *Ann. Rev. Microbiol.*, 5, 157 (1951).

<sup>3</sup> Cold Spring Harbor Symp. Quant. Biol., 11, 302 (1946).

<sup>4</sup> Lwoff, A., "Biochemistry and Physiology of Protozoa", 1-26. (New York: Academic Press, Inc., 1951.)