ture and from topography to electrical conductivity and seismicity. The second chapter focuses on the geological history of the Japanese arc, primarily during the Cenozoic era, with greater emphasis on the more recent events. In the last chapter, the authors discuss processes under island arcs, proposing a central hypothesis of descending flow beneath the arc. The authors had formulated this hypothesis, and apparently written parts of the book, prior to the advent of plate tectonics and the discovery of sea-floor spreading. They have attempted to incorporate these new concepts into the book, and in most cases have done so smoothly and successfully.

Because of the speed with which the subject of plate tectonics is developing, any book that discusses the subject is, in some regard, out-of-date when it is published, and this book has this shortcoming. However, it is by far the most modern and most comprehensive book on the subject of island arcs, and all but the most recent developments in plate tectonics are covered.

The book may be used by specialists and generalists as a source of information or of references. It might also serve as the text for a seminar, particularly one in which there are students with a variety of backgrounds.

JACK E. OLIVER
Department of Geological Sciences, Cornell University, Ithaca, New York

Electrons, Holes, and Monsters

The Fermi Surface. Its Concept, Determination, and Use in the Physics of Metals. A. P. CRACKNELL and K. C. WONG. Clarendon (Oxford University Press), New York, 1973. xii, 566 pp., illus. $48.

Everyone knows what a metal is and can describe many of its characteristics. It is safe to say, however, that few people would define a metal as "a solid with a Fermi surface." This may nevertheless be the most meaningful definition of a metal that one can give today; it represents a profound advance in the understanding of why metals behave as they do.

With this quotation from A. R. Mackintosh, Cracknell and Wong open the preface of this timely and well-written book. They lead the reader into the path of "Fermiology," one of the most actively studied subjects in modern solid state physics. The origins of Fermiology go back to the early days of quantum mechanics, when the basis of the Fermi-Dirac statistics for electrons was formulated: put in simple terms, it is that no two electrons can occupy the same quantum state. When the quantum states are defined in a perfectly periodic structure, they are defined or labeled by a wave vector (also called quasi-momentum) $\vec{k}$ which can be considered a continuous variable. In this highly idealized k-space, at very low temperatures, there should be for a metal a well-defined surface which separates occupied from empty states. Such surface is the Fermi surface, the subject and protagonist of the present book.

In the early days of the 1930's, the Fermi surface existed only in the minds of theoreticians, who thought of it as a collection of beautifully symmetric spheres or at most slightly distorted ellipsoids. Nature, however, decided, as usual, to give us more variety and almost endless complications. When the experimentalists could grasp the ins and outs of the Fermi surface—through a richness of experimental methods that were developed only in the 1950's and '60's—the subject of Fermiology became extremely active and full of twists, surprises, and unexpected physical effects.

In order to describe our present knowledge of the Fermi surface of metals, Cracknell and Wong have written this well-constructed book. In the first chapter, they start with the basic foundations of the electron theory of solids, which can be found in all standard textbooks on solid state physics. The concepts are presented clearly in such a way as to unify notation, properly define terms, and introduce the neophyte to the jargon of the field. Chapter 2 is devoted to the calculational methods employed by the theorists in determining Fermi surfaces. Such methods are many and sometimes not clearly related to one another: they have polarized the theorists in such a way as to create separate schools of band structure and Fermi surface "calculators" which sometimes are at odds with one another. In the book, the various methods are clearly presented and their common ground and significant differences then discussed. Chapter 3 gives a beautiful synopsis of the experimental techniques that yield information on those properties related to the Fermi surface. Here is the *real* physics, and here is where Fermiology becomes a reality susceptible of measurement.

The next two chapters are descriptive in character; they contain a detailed survey of the known facts about the Fermi surface of the metallic elements. The topological, geometrical, and differential properties of the many Fermi surfaces included in the text take the reader through a fantasy world of rather incredible creatures which bear whimsical given names such as hole surfaces, monsters, cigars, coronets, and crowns.

The last two, rather succinct, chapters examine briefly the validity and theoretical foundations of the hypotheses made originally, and the possible paths that must be followed when strong interactions are present in the electron "gas" or when periodicity of the crystal is destroyed by alloying.

Although monographs and review articles are by no means lacking in the field, this book is by far the most coherent and complete presentation on the subject. It assumes on the part of the reader a general basic knowledge of solid state physics in addition to a well-founded knowledge of basic quantum mechanics but requires no previous acquaintance with the complexities of Fermiology. The list of references is extensive, and the illustrations are many and very good.

My most serious complaint about this well-edited, well-printed, and well-presented book is the outrageous sum that the interested reader (or fund-starved library) will have to disburse to acquire a copy. Even the high price of gold these days does not justify such a sum for its Fermi surface.

L. M. FALICOV
Department of Physics, University of California, Berkeley

The Cyanophyta

The Biology of Blue-Green Algae. N. G. CARR and B. A. WHITTON, Eds. University of California Press, Berkeley, 1973. x, 676 pp., illus. $32. Botanical Monographs, vol. 9.

There has long been a need for a comprehensive text devoted to the general biology of blue-green algae. Whereas eukaryotic algae and other prokaryotic microorganisms have been the subject of numerous texts, information on the Cyanophyta has been either dispersed through other texts or confined to books dealing mainly with morphology and taxonomy.

This book will serve advanced students and researchers very well, for the editors have succeeded in their stated objective, "to give an account of most

aspects of blue-green algal biology that are of general interest, or are currently the subject of particularly marked activity." It does not purport to give a general description of the structure and functioning of a blue-green cell and is thus not an appropriate book for introducing students to this unique group of organisms.

Carr and Whitton have assembled contributions from over 20 authorities, all of whom have done an excellent job. The discussions of photosynthesis, nitrogen fixation, photoassimilation, fine structure, chemical composition, and general metabolism, all dealt with at length and very well referenced, are particularly valuable. One matter that is discussed in many chapters is the nature of obligate photoautotrophy and the limited heterotrophic potential of blue-green algae. All these chapters are well written in authoritative fashion.

In spite of the individual merit of the 25 chapters and four short appendices, I am a bit disappointed in the overall impact of this book. The contributions are mostly conventional in delineation of subject material, with emphasis on summarizing present data. Relatively little effort is expended to point out deficiencies in our understanding or to discuss challenging questions concerning organization and function of blue-green cells. The book does not, for instance, deal substantially with the localization and compartmentalization of enzyme units in an oxygen-evolving prokaryotic cell, with developmental phenomena in regard to cell differentiation, or with attempts to relate the structure and functioning of blue-green cells either to their exceptional abilities to survive high and low temperatures as well as desiccation or to their requirement for alkaline growth conditions. One exception to this is the chapter by Lazaroff, in which he nicely documents photomorphogenetic phenomena and also relates and interprets the data in regard to ecological significance.

In view of the fact that the editors have included six chapters dealing primarily with ecological considerations, it is surprising to find some important ecological subjects neglected. The whole topic of photorespiration, for instance, is mentioned only once, and that is in the chapter on nitrogen fixation in regard to competition for reducing power. Perhaps a more serious omission is that of mineral-element interactions, a subject which the editors have chosen to omit but which is nevertheless touched upon by several contributors. There is no mention of uptake mechanisms or uptake kinetics of nutrients, a subject that is of great interest in regard to the distribution and activity of blue-green cells in nature. Another point of concern involves the manner in which light intensities are reported. Most of the contributors (there are a few notable exceptions) use photometric units in discussing effects of light on algal metabolism, in spite of the fact that many photochemical processes are dependent upon the energy as well as the wavelength of the incident light. For such studies it is far more desirable to use radiometric units, as has been elegantly pointed out by J. E. Tyler (*Limnol. Oceanogr.* **16** (5), 841 [1971]).

The omissions will not detract from the value of this text for research workers. The book is amply illustrated. It is also well indexed in regard to subjects and organisms and will be particularly useful because of the cumulative author index of 115 pages. As a general reference source for authoritative information on blue-green algae, it will be of great service for many years.

OSMUND HOLM-HANSEN
Scripps Institution of Oceanography, University of California at San Diego, La Jolla

Growth Regulator

Ethylene in Plant Biology. FREDERICK B. ABELES. Academic Press, New York, 1973. xii, 302 pp., illus. $18.50.

When, in 1901, Neljubov discovered that ethylene in the air influenced the growth of pea seedlings, he had no idea that he had discovered one of the most important growth regulators of plants, which now is slowly being accepted as the only gaseous hormone yet encountered. Ethylene-regulated phenomena include: breaking of dormancy, regulation of cell elongation, epinasty, induction of roots and root hairs, hypertrophy, exudation, flower induction, fruit ripening, senescence, and abscission. Ethylene also induces enzymes, changes pigmentation, and regulates respiration, nucleic acid and protein metabolism, and other, less important processes.

Ethylene, as far as we know, is produced to some extent in every cell of higher plants, and its production is regulated by the level of other plant hormones such as auxin, gibberellins, cytokinins, abscisic acid, and a whole range of growth retardants. The production of ethylene increases in plants under stress, regardless of the cause of the stress. A variety of organisms produce ethylene at different rates, and the production is under the influence of the environment surrounding the plant. Biochemical pathways from which ethylene evolves may also differ, depending on the type of organism. Several ethylene analogs have been used to elucidate the mechanisms of action of this gaseous hormone, the threshold levels for the action of which are not uniform.

All these matters are discussed in detail in *Ethylene in Plant Biology*. The only place I felt more detail was needed was in the discussion of the biosynthesis of ethylene. Even our incomplete knowledge of this subject is more than that included in the text.

The real value of this book is in collecting the information about ethylene and classifying its effects. The author has done a skillful job of including and illustrating all the important information. After reading the book the uninitiated person, whether he is a student, a teacher, or a researcher not directly engaged in ethylene research, will unquestionably know the role of ethylene in plant biology, just as the title indicates. The author may have intended to write the book as a general reference and to stop at that. However, he leaves the appetite of scientific connoisseurs unsatisfied in that in most controversial cases he merely presents the facts without any attempt to interpret them. This may not be a fault, but Abeles is one of the few persons who is in the position to interpret the available data, and interpretation would add much to the usefulness of the book.

In the past, plant growth has been manipulated by the application of substances that affect the amount of ethylene generated by the plant. Defoliation is the best-known example of this. With the development of new chemicals such as ethephon that are directly converted to ethylene by the plant, the use of ethylene in growth regulation will greatly increase. For this reason, the appearance of this book is timely, and the book is recommended for those who are interested in the subject or want to have a reference book on the work done on ethylene before 1972.

MIKLOS FAUST
Fruit Laboratory, U.S. Agricultural Research Service, Beltsville, Maryland