systematically pursued and coordinated with the results of the field searches.

Muhly ends his book with the comment that it is only the beginning of his research. Much work indeed is being accomplished each year by him and his scientist-colleagues. It will be useful for the reader of the book to consult some of the recent progress reports and summaries—for example, J. D. Muhly, "Tin trade routes of the Bronze Age," *Am. Sci.* **61**, No. 4, 404 (1973), and T. A. Wertime, "The beginnings of metallurgy: A new look," *Science* **182**, 875 (1973)—as an introduction to and summary of the modern state of the problems. These articles also offer maps which the book does not provide. They could inspire the reader to give up consecutive reading of *Copper and Tin* in favor of selective consultation, to which the book is and will remain especially suitable and through which its valuable contributions will be best discovered.

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Muscle Pigment

Myoglobin. Biochemical, Physiological, and Clinical Aspects. LAWRENCE J. KAGEN. Columbia University Press, New York, 1973. xiv, 151 pp., illus. $10. Columbia Series in Molecular Biology.

Research on myoglobin has been overshadowed by that on its larger cousin, hemoglobin, but this muscle pigment is coming into its own. The transport of O_2 from intracorpuscular hemoglobin in the capillaries to the cellular sites of its reduction is under intense investigation today, stimulated in part by apparent changes in tissue O_2 partial pressure (pO_2) and O_2 delivery produced by changes in the affinity of hemoglobin for O_2. These results have come both from studies on laboratory animals and from a spectrum of clinical findings. Myoglobin is widely distributed in muscle, which represents some 40 percent of vertebrate body mass, and is assumedly involved with O_2 transport. Therefore its respiratory function should be of great significance in total body metabolism, and yet certain critical knowledge about it is lacking today.

This book, one of the Columbia Series in Molecular Biology edited by Ernest Borek, provides an up-to-date synopsis of our knowledge about myoglobin for the reader with basic knowledge in the field. It is weighted in favor of the interest of the author in an immunological approach to the study of myoglobin. Physical chemistry is presented rather briefly; for example there is no mention of the kinetics of the reaction of oxygen and myoglobin, while the amino acid sequences of myoglobin of various species are dealt with extensively. The book contains a brief history of our knowledge of myoglobin, a discussion of its biochemical aspects, including excellent tabular summaries of the amino acid sequences, and of its physiology, including its distribution in the tissues of a variety of animals, its localization in cells, factors altering its concentration in the tissues, and its synthesis and degradation. These are followed by a discussion of immunological studies and a large chapter on clinical aspects such as genetic variants and conditions characterized by myoglobinemia and myoglobinuria. Important matters of present uncertainty such as the existence of fetal myoglobin and the precise localization of myoglobin in the muscle cell are pointed out and the evidence summarized. I would have preferred that more attention be given to the greater question, that of the function of myoglobin.

The book is clearly written, eminently readable, and conveniently small. It represents a practical compromise between an introductory text and a review *in extenso*. The paper is unglazed, to the reviewer's pleasure. In spite of the small size of the book, the bibliography contains more than 500 references.

The book is recommended for the clinician or basic scientist with an interest in the physiology and pathophysiology of muscle. Even the expert will profit.

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Symbionts

The Lichens. VERNON AHMADJIAN and MASON E. HALE, Eds. Academic Press, New York, 1973. xiv, 698 pp., illus. $35.

Lichen formers make up about half of the some 50,000 species of the Ascomycetes, the largest group of the Fungi. The Ascomycetes that early took up life with algae abandoned their saprophytic origins and invaded the harshest habitats (bare rock, for example), where competition was low or nil, and there they diversified. Most mycologists cannot name to genus the commonest lichens that they see around them, and textbooks of mycology regularly dismiss the lichens with a page of platitudes on symbiosis. For all its merit *The Fungi: An Advanced Treatise,* edited by Ainsworth and Sussman and with volumes appearing since 1965, also overlooks this conspicuous mass of Fungi, and, aware of this, the publishers commissioned the present book on the lichens, which offers a broad yet scrupulously detailed synthesis of an astonishingly diverse literature.

Nineteen chapters deal with every major area of contemporary lichenology: structure and development, physiology and ecology, chemistry of secondary natural products, symbiosis, and systematics. All the chapters are in English, but strangely no mention is made of the fact that some are translations. The lack of any appreciable overlap among the papers points to a careful collation of the contributions of the 23 authors (representing 11 nationalities) by the editors.

The Lichens is filled with outstanding reviews. For example, an article entitled "Sexual reproduction" becomes Letrouit-Galinou's vehicle for discussing the highlights of 25 years' work on the structure of the ascus and ascocarp by Chadefaud's group in the Sorbonne. The large, convoluted, almost exclusively French literature on this subject has never before been summarized in English. Peveling brings order from the many recent fine-structural studies on the individual symbionts and on the nature of their physical contact. Richardson describes the elegant experiments on carbohydrate movement between symbionts carried out by D. C. Smith and his co-workers at Oxford. The fantastic temperature extremes and water stresses that lichens endure and that account for much of their unique ecology are masterfully summarized by Kappen in one of the book's longest and best chapters. But perhaps most telling of all are the chapters that are not there. There is no "Paleontology," for these ancient double organisms left no fossil record; and there is no "Genetics," reminding us that in this vast group still not even so much as one unequivocal chromosome number is known.

Why have the abundant lichens not been even more extensively studied?