diagrams as compared to photographs. This monographic treatment will be useful for years; the bibliography contains 1005 references including many antedating Calkins and Summer's *Protozoa in Biological Research* (1941), to which this volume is apparently a successor. This makes the review more valuable, because the authors have made a massive synthetic effort. In contrast to the first offering, there are remarkably few lapses of form, evidence that this was a work of love. A quarrel might be raised with the section on the taxonomic significance of sarcodine movements, since it seems to be dragged in by its trailing pseudopod, but one is compensated for this by the Summary and Postlude which blazes trails in research on the motile behavior of protozoa for years.

The discussion of Respiratory Metabolism by W. F. Danforth is able and timely. It lacks also editorial cleanliness when, for example, both *Trypanosoma cruzi* and *T. cruci* are used in the same paragraph. A ticket for literature and traffic congestion should be issued for continuing to use DPN and TPN for NAD and NADP against the rules of international bodies of enzyme nomenclature. Danforth does point up the fact that the discovery of new and unexpected respiratory mechanisms in protozoa has been relatively rare, which is an awakening on the part of those who have been expecting great and magnificent differences. This lack of great differences illustrates what I choose to call evolutionary parsimony—a conservancy seen in all biological systems from molecule to community.

The article by J. A. Kitching is evidence that the advances made in the understanding of morphology and function of contractile vacuoles with electron microscopy and the more sophisticated experimental techniques have made vacuolar function, if not definitively established, more understandable to the biologist.

R. P. Hall's discussion of nutrition and growth of protozoa meets most of the criteria I cited above. He asks questions in an apt synthesis of this vast and diverse field of study. I especially enjoyed his section on the ecological aspects of nutrition and metabolism. Here we see careful correlation of the environment with the organismic needs. In trying to relate the effects of *p*H, temperature, and osmotic relationships on nutrition and metabolism, he avoids with justifiable care the interrelationships quicksand that most fall into.

The succeeding volumes will best help to evaluate this series. All in all, this volume comes off well. The indexes (organism and subject) suffer from malnutrition and some may argue that the bibliographies are obese. The format, especially the figures and illustrations, is excellent. The price (since there will be three additional volumes) may restrict the bookshelves on which it is found to those of libraries and of protozoologists. The latter must have it at hand.

RALPH E. THORSON
Department of Biology, University of Notre Dame, Notre Dame, Indiana

Johnson Colloquium

Hemes and Hemoproteins. BRITTON CHANCE, RONALD W. ESTABROOK, and TAKASHI YONETANI, Eds. Academic Press, New York, 1966. 640 pp., illus. $13.75.

On 16 and 17 April 1966 some 65 biochemists, crystallographers, theoreticians, and physical chemists gathered at the Johnson Research Foundation of the University of Pennsylvania to discuss aspects of hemes and hemoproteins. This was the third colloquium of the Johnson Foundation. The volumes reporting the preceding colloquia, *Energy-Linked Functions of Mitochondria* (1963) and *Control of Energy Metabolism* (1965), each appeared in print within a year of the meeting. The present volume continues in this admirable pattern; it was on the booksellers' shelves within ten months. Within this short time the editors constructed an exhaustive index which makes it easy for the reader to refresh his memory or to pull together differing treatments of related topics from among the 63 papers and discussions representing contributions by 122 authors.

This, following the 1959 Canberra and 1964 Amherst symposia, is the third recent symposium devoted in large part to hemoproteins, but it differs in purpose and does not duplicate the earlier volumes. Those volumes emphasized the chemist's and the biochemist's approach, and many of the articles reviewed particular proteins or protein systems. The present colloquium is in the nature of a workshop which, starting with a consideration of heme and its binding proteins, is primarily devoted to the interaction of the protein-bound heme with ligands. The participants have applied a bewildering number of physical methods to the study of hemoproteins. These include recently developed sensitive and rapid optical techniques, electron-spin and nuclear-magnetic resonance, volume magnetic susceptibility, optical rotatory dispersion, Mössbauer studies, and kinetic studies both by flow methods and photolytic techniques.

Diversity is the particular strength of the colloquium. Few of us would be able unaided even to be aware of all the disciplines represented in this volume, much less to select and assimilate the relevant experiments from the onrushing flood of literature. This the organizers have done very well indeed, and it is a rich feast they present. Is it digestible? Some contributions, particularly those on structure of hemes and hemoproteins, are statements of accomplished fact. One contribution retells important early experiments, which badly need repetition by modern techniques. Most of the contributions tell what was going on at the moment in time that the meeting interrupted them. They are fragmentary, timely, exciting, and in a few cases so preliminary that they already require revision. I found the papers on reactions in the crystalline state and those on ligand binding and reaction mechanisms of oxidases particularly timely and the discussions following particularly challenging. The section on hydroperoxidases omits some important current trends. The overall impression is that of a newspaper photograph fixing every detail unselectively. The discussions are the best feature of the book. They are combative and entertaining, and the contestants do not flag even after the 63rd paper on the second day. I suspect that students will be bewildered by this volume and that scientists at large will find it too specialized to assimilate. Workers in the field of hemoproteins, however, have good reason to thank the editors and participants for making us party to their discussions.

JONATHAN B. WITTENBERG
Albert Einstein College of Medicine, Yeshiva University, New York City