Virology after 14 Years of Discovery

General Virology. S. E. LURIA and JAMES E. DARNELL, JR. Wiley, New York, ed. 2, 1967, 528 pp., illus. $12.50.

The first edition of this book appeared in 1953, a momentous year for biology. For in 1953 was published the revolutionary paper of Watson and Crick in which they elucidated the structure of DNA and simultaneously proposed a mechanism for its replication. That paper, a cornerstone of modern molecular biology, not only offered insight into the mechanism of DNA replication but also introduced a new intellectual frame of reference to the scientific community. It was fortunate that *General Virology* appeared just before this revolution. Because at that time little information was available on the molecular biology of viruses Luria was forced to concentrate on the *biology* of viruses, and the result was a masterly survey of the phenomenology of virology. *General Virology* proved to be a source of stimulation and inspiration for a whole generation of old and new virologists, and the first edition still has much to recommend it.

The second edition will not replace the first but will rather supplement it, for most of the research in virology since 1953 has been of a different character. In 1953 there was a firm foundation of techniques of bacteriophage research which made these viruses the ideal models for later studies on the replication and transcription of DNA. Inevitably, many of the studies on the molecular mechanism of DNA replication were accomplished by using the T-even series of bacteriophage. But many important developments in the study of all types of viruses were reported around this time. In 1952 Dulbecco developed techniques for the quantitative study of animal viruses which permitted the same type of analysis which was being used so successfully by the bacteriophage workers. The demonstration of DNA as the genetic material of bacteriophage by Hershey and Chase in 1952, of RNA as the genetic material of tobacco mosaic virus by Gierer and Schramm in 1956, and the induction of mutations in tobacco mosaic virus by treatment with nitrous acid by Mundry and Gierer in 1958 must be considered among the monumental achievements which led to a continuing expansion of research and knowledge in virology. These overwhelming advances are reported here as they are in no other single source presently available.

Since the second edition has only 81 more text pages than the first, it is obvious that presentation of the massive amount of knowledge accumulated since 1953 has been accomplished by elimination of large portions of the original text. There has also been considerable rearrangement of material, with subjects to which chapters were originally devoted now occupying only a few pages or paragraphs. In carrying out this revision the authors have emphasized the molecular and biochemical aspects of virology, but fortunately the broad biological viewpoint has not been lost.

This book should appeal to two audiences, the beginning students of virology and the experienced workers in the field. But I recommend the book to beginning students with the reservation that it be used only in conjunction with a formal course and not for independent study. I shall cite two examples to illustrate the need for guidance. (i) The description of the formal genetics of bacteriophage is not very clearly presented. Granted it is a difficult subject, but for a textbook approach the more lucid qualitative description of Hayes [*The Genetics of Bacteria and Their Viruses* (Wiley, 1964)] is preferable to a semi-quantitative approach with a smattering of underived equations. (ii) The analogy between virus-transformed tumor cells and lysogenic bacteria is emphasized in the chapter on tumor viruses. Although at least part of the genome of some DNA tumor viruses may be integrated into transformed cells, there is no evidence that this occurs in the case of the RNA tumor viruses. We read, nevertheless, the following: "In summary, the findings on two major groups of tumor viruses contribute to a consistent picture that forms a useful model on which further work can be based. According to this still unproven model, viral nucleic acid integrates with the host genome and specifies one or more proteins that enter the cell membrane, causing loss of contact inhibition." Even at the time of publication, this concept was in disrepute for the RNA tumor viruses, and recent experiments have made it unlikely that the lysogenic model has any relevance for this group. I refer here to the demonstration of infectious Rous sarcoma virus particles in "nonproducer" cells. Emphasis on the lysogenic concept in relation to all tumor virus would have been avoided if this most recent information had been available; this brings up the inevitable datedness of a book in a field still expanding with breathtaking rapidity.

Because of its broad perspective the mature virologist can also profit from this book, which can counteract the narrow vision necessary for examining single shards rather than the finished pot in one's search for truth. It also can be recommended, albeit with the reservations applicable to students, as an excellent introduction to virology for research workers in more distant fields.

On balance, the authors have achieved a remarkable synthesis of the state of our knowledge of virology as of mid-1966. No comparable book is available at present.

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Review of Protozoa

Research in Protozoology. Vol. 1. TZE-TUAN CHEN, Ed. Pergamon, New York, 1967. 436 pp., illus. $17.

My goals for books of this type are (i) currency, (ii) authority, (iii) quality of individual presentations, (iv) synthesis but not a cataloging of the literature, and (v) editorial excellence. Few volumes satisfy all of these, and this book is no exception, especially with respect to (iii) and (v).

There are five contributions in this volume. E. Anderson's presentation of organelles and inclusions is less than satisfactory on all the above counts. It is especially marred by rather extensive misspellings or transpositions, all of which should have been spotted by an eagle-eyed editor. This chapter is merely a catalog and an album of photographs (all excellent) of items found in many texts. On the other hand, the contribution of T. L. Jahn and E. C. Bovee meets all my criteria, with the bonus that their chapter illustrates the utility of excellent line

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.

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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.

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