reinforce for truth, they do not appear to reinforce for grammatical completeness or well-formedness.

Brown brings to the work the attractive personal style and unusual lucidity for which he is well known. However, the field's unresolved issues that demand examination of much complicated detail, together with Brown's resolute refusal to oversimplify, tax these attributes severely. Readers from outside the immediate area will find the book difficult. Nevertheless, I predict that its thoroughness and thoughtfulness will make it the outstanding work on its topics until either the issues it analyzes are resolved or the *Zeitgeist* changes again.

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Animal Viruses

Viruses and Invertebrates. A. J. GIBBS, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1973. xvi, 674 pp., illus. $60. Frontiers of Biology, vol. 31.

It is not surprising that a team made up mostly of Australian and British virologists, who have long been among the leaders in medical virology, particularly in the study of structure, function, and immunochemistry, should prepare an outstanding volume in comparative virology.

This book is divided into five major sections. The first contains brief historical accounts by Andrewes, Smith, and Watson of the three major groups of viruses. Each is rather subjective but all succeed in presenting most of the important contributions. This is not the strongest section of the book.

The second section describes the viruses and the invertebrates with which they are associated. In general, this section is very well done. The newest systems of virus nomenclature and acronymic designation are effectively combined by Bellet, Fenner, and Gibbs to provide the most up-to-date scheme for virus classification. There follow nine chapters (by Hoogstraal, Lee, Eastop, Kisimoto, Selman, Entwistle, Mattingly, Hooper, and Mound) devoted to the structure and habits of mites, ticks, aphids, thrips, leafhoppers, beetles, mosquitoes, flies, and nematodes. Modes of virus acquisition, multiplication, and dissemination are emphasized.

The third section covers virus penetration, replication, and physiological reactions in invertebrates and in cultured cells from invertebrates. Gaps in our knowledge are clearly evident, and the contributors (Dalgarno and Davey, Harrap, Lafferty and Crichton, and Grace) present most of the current information in an objective manner.

In the fourth section, more specific virus-host associations are presented (by Hoogstraal, Slykhuis, Marshall, Longworth, Bailey, Roivainen, Peters, Garrett, Sinha, Harrison, and Gibbs) in ten detailed and comprehensive chapters. This section complements section 2 very well, and the two constitute the most useful part of the book. Associations affecting man, other mammals, birds, and plants are included.

Section 5 summarizes the progress that has been made in the manipulation of viruses for the benefit of man. Bailey's chapter on the control of invertebrates is objective, succinct, and fairly comprehensive. The same may be said for the next chapter, by Gordon Smith and Surtees, on the control of viruses spread by invertebrates to man and mammals. The final chapter of the book, by Heathcote, is also thorough in its treatment of plant viruses spread by invertebrates.

Despite its high price this volume will undoubtedly become indispensable to the research scholar who is interested in the relationships of viruses with man, mammals, and birds, with plants, as well as with invertebrates. It is obvious from this book that there is much to learn about all of these associations, and the authors have posed many of the important questions remaining to be answered.

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The Herpes Group

The Herpesviruses. ALBERT S. KAPLAN, Ed. Academic Press, New York, 1973. xvi, 740 pp., illus. $31.

The recent findings that herpesviruses are associated with cancer in animals and—though the evidence is less conclusive—in humans led to an upsurge of interest in them. The book is offered as a collection of "the currently available information on *all* the herpesviruses." *All* herpesviruses? The editor states that "it would be clearly impudent and possibly impossible for one individual to attempt to write authoritatively about all aspects of herpesviruses" and promises that this volume will not be a "mere annotated bibliography."

The book is admirably organized in 21 chapters that fall roughly into three groups. The first group comprises chapters by P. Wildy, unquestionably the doyen of modern herpesvirology, two chapters by D. H. Watson on electron microscopy of the virus and its development, a chapter by G. A. Gentry and C. C. Randall on physical and chemical properties, and chapters by R. W. Darlington and A. Granoff and by T. Ben-Porat and A. S. Kaplan on replication. The second group deals with immunology of herpesviruses, interferon, and latent infections. The last contains 12 chapters dealing with individual or groups of herpesviruses, the relation to the disease they produce, and chemotherapy.

Not too surprisingly, the best chapters in the book are in the third group. I would like to single out the chapter by George Klein on the Epstein-Barr virus as a model of concise, factual, authoritative writing. The chapters by D. G. McKercher on herpesviruses and lower animals, by P. M. Biggs on Marek's disease, by K. Wolf on herpesviruses and lower vertebrates, by W. E. Rawls on herpes simplex, and by F. Deinhardt on herpes saimiri come close seconds and should be most useful to both expert and neophyte.

Omissions, biases, and poor editing abound in the first and second sections. Nowhere, for example, is there a thorough discussion of the role of cellular immunity in herpetic infections. Judging by what has been left out, most of the bibliography dates to 1971 (chapters on virus structure) or the middle of 1972 (viral replication). Contrary to the editorial promise, it is hard to view the chapter on physical and chemical properties of herpesviruses as anything more than an annotated bibliography; it is written to offend no one, least of all the editor. Uncritical statements concerning herpes simplex viruses causing cell proliferation (p. 117) rather than piling up of dead cells and amitotic nuclear division (p. 115) rather than nuclear fragmentation in infected cells are made in the chapter by Darlington and Granoff. If some of the chapters lack critical insight, the chapter by Ben-Porat and Kaplan suffers from an overindulgence in speculation based, sometimes, on no facts at all. I was particularly amused by the rather critical discussion (p. 172)

of experiments attributed to Sydiskis and Roizman (1967) which, alas, these authors have never done. This is but one of several examples. The authors still cling to the notion that some viral polypeptides are synthesized in the nucleus (p. 190), that analyses of detergent-treated (although this fact is obfuscated) nuclei yield meaningful measurements of lipids in the nuclear membrane. I was also puzzled by the apparently profound conclusion (pp. 194–196) that whereas virus-specific antigens are integrated into plasma membrane, viral proteins are not. I would recommend that the reader use the chapter as a source of bibliography and ignore the text.

On the whole, despite the foibles, this is a good book. The bibliography alone is worth the money. The many superb chapters constitute a worthy foundation and source of information on many aspects of herpesviruses for years to come.

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Ciliates

Biology of Tetrahymena. ALFRED M. ELLIOTT, Ed. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1973. x, 508 pp., illus. $35.

The ciliate genus *Tetrahymena* looms out of obscurity into the latest textbooks of cell biology. Unfortunately, however, many biochemists using it know little concerning its life cycle, and its morphologists are often similarly uninformed about its molecular and physiological properties. Elliott's new volume, if read carefully, may improve the situation dramatically. The contributed chapters cover the many fruitful lines of experimentation that have developed since the capture of *T. pyriformis* in sterile culture in 1923. Among the potentially more bewildering topics that are reviewed with clarity, special mention must be made of gluconeogenesis, physiological control mechanisms, nucleic acid pathways, and genetics. The "general bibliography" at the end of the volume contains 1687 references cited in full, accounting for about 60 percent of the publications relating to this genus.

A number of important technical caveats are aired, but there is one outstanding omission: strain designations relating to forms lurking under the "taxonomic umbrella," *T. pyriformis*, are known to be thoroughly confused. Failure to repeat someone's result may simply mean that your "strain W" is different from his. Worse, the issue of cryptic species within the nominal species *T. pyriformis* continues to be ignored, in the face of ample documentation of genetic and phenotypic diversity. There is general agreement among the contributors that "if the concept of a biological species were adhered to," the breeding groups (syngens) would qualify as separate species. But no one is willing to venture why the biological species concept should *not* be adhered to. Otherwise, the chapter on taxonomy, by John O. Corliss, is unusually detailed and restrained. Most contributors have cited many sets of contradictory results, a number of which are resolved satisfactorily. At least part of the remaining discrepancies must be due to strain differences, the recognition of which might also disarrange some proposed metabolic pathways based on a composite of several strains.

Owing to a long delay in publication, progress has far outstripped several chapters, which may seem rather staid because particular contributors tired of waiting and published similar reviews elsewhere. By far the longest and, in my opinion, the best chapter is by Sally Allen and Ian Gibson, covering the extremely difficult subject of *Tetrahymena* genetics with admirable precision. Allen and Gibson have also concocted an imaginative new model for the organization of the macronucleus, fetchingly illustrated by the symbols $, ¢, £, d. If the reader can suppress his hysteria sufficiently to turn the page, he is greeted by a further illustration, this time with hearts and flowers. The new model supposes replicating "'master" and nonreplication "slave" copies of individual "replicons," with 45 "slaves" for each "master" to account for the ploidy of the macronucleus. Unfortunately the new theory is at odds with the results of density-label experiments indicating that most, if not all, of the DNA replicates semiconservatively during one cell cycle. How this ciliate organizes its vegetative nucleus remains a real puzzle, among a host of others equally baffling.

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