

Book Reviews

Microbial Herbivores

Biochemical Aspects of Plant-Parasite Relationships. Proceedings of a symposium, Hull, England, Apr. 1975. J. FRIEND and D. R. THRELFALL, Eds. Academic Press, New York, 1976. xiv, 354 pp., illus. \$23.50. Annual Proceedings of the Phytochemical Society, No. 13.

I am reading this volume in a lowland tropical rain forest, an appropriate place to contemplate plant-parasite interactions. It is almost constantly wet here and never very cold; microbial growth is not restrained by weather. Every plant bears fungal colonies or epiphyllae, and the decay from bacterial digestion begins in foliage within hours after it is cut or falls from plants. Yet the forest is healthy. None of the 500 or so plant species within walking distance is obviously debilitated by disease, and most leaf area of most plant species is apparently free of microbial activity. The burns, blazes, spots, and lesions of infection are tiny and rare on all but the oldest leaves, even on plants that retain leaves for many months. This is the ultimate enigma of host-parasite interactions. What are the mechanisms and mechanics of the equilibrium between hosts and parasites? That the balance is unstable we see in the case of plagues, pest outbreaks, and disease epidemics in agricultural plants; that it is not simple we see in the plethora of diseases suffered by every plant species. Obviously, the questions of plant pathology are ecological, epidemiological, and morphological as well as biochemical.

Fortunately, in spite of its title, the orientation of *Biochemical Aspects of Plant-Parasite Relationships* is not merely biochemical, and its content is germane to broader issues of plants and their parasites. In the lead chapter, T. F. Preece gives an ecologically insightful perspective of the sequence of events in fungal immigration onto, and colonization of, leaves. D. J. Royle's account of structural factors in disease resistance in plants is introduced with the observation that, since the advent of modern biochemical techniques, serious research on the morphology of plant-parasite inter-

actions has waned. But the external form of plants seriously affects disease resistance, in complex ways. Spines, hairs, wax, and leaf shape, for example, influence the rate of spore washing from leaves, and these influences differ among microbial species as a function of spore wettability. In another chapter on structure, D. S. Ingram, J. A. Sargent, and I. C. Tommerup summarize the anatomical aspects of leaf infection by fungi. The enzymology of plant cell wall hydrolysis by fungi is described by D. F. Bateman and protoplast killing by R. K. S. Wood, in biochemical discussions complementary to those of the chapters on morphology. Other aspects of the physiology of pathogens growing inside plants are covered in G. A. Strobel's chapter on the poisoning of plants by invading fungi and in J. Friend's on lignification of infected tissue. A diversity of topics completes the volume: there is a chapter on the nucleic acid metabolism of plant pathogens by J. A. Callow, one on pathogenic microbes in the soil by J. R. Coley-Smith, one on the influence of host plant genetics on pathogens by R. Johnson, and chapters on phytoalexin-like substances by several authors.

Phytoalexins are, properly, antimicrobial substances synthesized by plants after infection, but many compounds that kill microbes *in vitro* are found in plants independently of infection. Speculation in this volume on the evolutionary causes and physiological functions of phytoalexins parallels that in the literature concerned with the role of secondary plant substances in insect-plant interactions. In both there are the skeptics, who see the antibiotic properties of plant products as fortuitous or even artifactual, or as metabolic storage or waste products. The proponents of these views are often chemists or cell physiologists, and experiments to discover the functions of these substances in natural situations are usually not suggested. In the opposite corner are the question-begging evolutionists, who enthusiastically imagine deterministic antibiotic roles for each novel compound. These are usually whole-organism biologists who do not carefully differentiate between fact and imagination and whose enthusiasm for

critical tests of their notions is often not equal to their speculative creativity. In the volume at hand, B. J. Deverall takes a refreshingly scientific view of all this. He suggests that the roles in plant disease resistance of most phytoalexin-like compounds are not yet demonstrated and that a major emphasis of research should now be on the evaluation of these roles in real parasite-host interactions. In my opinion he is correct, and the possibility that such compounds have no function should be entertained in this research. This does not mean that there has never been a function for some compounds, but that some may fall into disuse in an evolutionary sense.

Herbivorous arthropods might be considered plant parasites on the order of the pathogenic microbes that are the subject of this volume. Plants are simultaneously attacked by both arthropod and fungal parasites, and it is unfortunate that researchers have not yet taken this into account. For example, some supposed phytoalexins could also render protection against insects, either directly or via microbial symbionts of insects. Surely, the damage done to plants by insects is a major mode for the introduction of microbes into plant tissues that are effectively protected by external morphology, as described in this volume. Research on plant parasites in the broad sense will mature only when microbial researchers join arthropod researchers. Only then might the vexing questions of the function and origin of novel plant products have a high probability of being answered.

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Coastal Plants

Seagrass Ecosystems. A Scientific Perspective. Papers from a workshop, Leiden, The Netherlands, Oct. 1973. C. PETER MCROY and CARLA HELFFERICH, Eds. Dekker, New York, 1977. xii, 314 pp., illus. \$29.75. Marine Science, vol. 4.

Shallow coastal waters dominated by seagrasses are among the most productive areas of the world's oceans. In daily photosynthetic fixation of organic carbon seagrass ecosystems often exceed both coral reefs and areas of oceanic upwelling.

The study of seagrasses, the underlying sediment, the overlying water column, and the associated animals and

plants as a complete system was originated by the Danish scientist C. G. J. Petersen around the turn of the century. Now, 70 years later, this approach has received a boost from the U.S. Office for the International Decade of Oceanic Exploration, which is supporting a long-term program of seagrass research utilizing the ecosystem concept.

An early step in the IDOE seagrass program was a workshop held in 1973. *Seagrass Ecosystems* stems from that workshop.

The book is both useful and disappointing. It contains nine papers, of which six are basic reviews covering the productivity and physiology, systematics, decomposition, consumer ecology, and chemistry and geochemistry of seagrasses and the wasting disease of eelgrass. These papers are uniformly clear, well organized, and comprehensive. They are weakened only by the almost total lack of references more recent than 1973. Why it took four years to publish an offset-printed book of nine papers that were largely completed in 1973 is not explained.

One might question the inclusion of the three final papers summarizing seagrass research in Mexico, Australia, and Israel. These papers were written after the workshop, and they hardly seem compatible with the six process-oriented papers.

Still, for anyone interested in seagrass ecosystems this book is a logical starting point for reviews of pre-1974 research.

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Paleophycology

Fossil Algae. Recent Results and Developments. Papers from a symposium, Erlangen, West Germany, Oct. 1975. ERIK FLÜGEL, Ed. Springer-Verlag, New York, 1977. xiv, 376 pp., illus. \$36.10.

A few years ago, biogeologists with an interest in algae had only a few references—most notably monographs by Maslov, Pia, and Johnson for fossil algae and Fritsch, Geitler, and Bourrelly for recent algae—to turn to. Today the situation is much different; the literature explosion has hit algal studies. *Fossil Algae*, which contains 37 of the papers presented at an international symposium on the subject, is one of the latest entries in the paleophycological sweepstakes.

The book covers a wide spectrum of subjects having to do with ancient algae, from the interpretation of microbial fossils found in Precambrian cherts (Golubic and Barghoorn) to the paleogeographic significance of some Miocene rhodolites (Orszag-Sperber *et al.*). It is concerned primarily with algae, recent as well as fossil, as related to carbonates, but coccoliths are omitted.

The review by Claude Monty on the nature and ecological significance of stromatolites is a gem. I think I finally understand what Kalkowsky meant by "stromatolith." Aside from the report by Krumbein and Cohen of facultative anoxygenic cyanophytes forming algal mats and Riding's account of skeletal stromatolites, I found little new and exciting in the ten remaining stromatolite-oriented papers.

The strength of *Fossil Algae* lies in its coverage of Phanerozoic and Recent calcareous algae (23 papers). Though rather heavily weighted in favor of red algae, the papers offer up-to-date accounts of dasyclads, algal carbonates, algal paleoecology, problems of algal affinities, and algal phylogeny.

Paleoecologists—they need not be algal enthusiasts—should look at this volume and pay particular attention to the last 12 papers, which deal with algae and sedimentary environments. Too few paleoecologists are able to recognize and use calcareous algae in their syntheses. This last section contains papers (such as those by Abate *et al.*, Flügel, and Tsien and Dricot) that have photomicrographs and distribution data that should help in overcoming that deficiency.

Flügel did a fine job of selecting the papers, and the book has excellent generic and species name and subject indexes.

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Quantum Chemistry

Quantum Mechanics of Molecular Conformations. BERNARD PULLMAN, Ed. Wiley-Interscience, New York, 1976. x, 412 pp., illus. \$32.50. Perspectives in Quantum Chemistry and Biochemistry.

This volume is an auspicious beginning for a series intended to provide an interdisciplinary survey of the major developments in the application of the concepts of quantum mechanics in various fields of chemistry, physics, biochemis-

try, biophysics, and pharmacology. Each book in the series is to be "devoted to a *specific subject* of major significance," and "the aim is to demonstrate the importance of the quantum mechanical approach in each of the selected fields for all types of molecules." This strategy is well conceived, and the resulting volumes, being self-contained and coherent, should be much more useful than those of the customary "advances" or "reviews" series.

The present volume is devoted to a description of quantum-mechanical computations used in the study of molecular conformations and to the extension of such computations to a wide range of molecular systems, from small inorganic compounds to biopolymers and their constituents.

In the first chapter, entitled "Small molecules and inorganic compounds," A. Veillard reviews the LCAO-MO-SCF method (linear combination of atomic orbitals to form molecular orbitals by a self-consistent field technique), the choice of expansion basis sets (Slater versus Gaussian functions), the bond orbital approach, correlated wave functions, the semiempirical SCF methods, among which he includes CNDO, INDO, and MINDO (complete neglect, intermediate neglect, and modified intermediate neglect of differential overlap), and the extended Hückel method. He does not mention the use of *ab initio* effective core model potentials, a theoretical method that has not yet been used extensively for conformational analyses. This method enables one to treat only the valence electrons explicitly, yet to obtain solutions comparable in accuracy to *ab initio* calculations retaining all the integrals. The development of this method will have a profound impact on the feasibility of conformational analyses, especially for molecules containing four or more even first-row atoms. It will cut the amount of computer time necessary for such calculations so significantly that it may well make them competitive with less rigorous methods. Veillard also omits the use of improved virtual orbitals or multi-configuration (MC) SCF, by itself or as a starting point for more rapidly converging CI (configuration interaction) expansions. The omission is no doubt due to the paucity of conformational analyses using these techniques.

Veillard's review is especially valuable in that he compares the reliability of conformational analyses done by the different computational methods. Particularly important are the instances he cites of the failure of the CNDO method,