essays by members of the Nuffield Unit of Medical Genetics.

By and large, the articles are serious reviews, or specific treatments, of mature topics; thus the book emerges as a distillation or reinforcement of older ideas, not as a reaching for new ones. There is a distinct historical flavor; this is suitable in view of Ford's special position in the development of evolutionary biology. In the 1930's, Fisher, Haldane, and Wright laid the theoretical cornerstone of evolutionary thinking in this century. At about the same time, Ford commenced the construction of the edifice with data taken from nature. He had few peers in those days, perhaps only Dobzhansky, and I was delighted to find that the latter has contributed a characteristically lively essay on historical genetic changes in populations of *Drosophila pseudoobscura*.

The introduction to the bibliography refers to the "relentless excellence" of Ford's work. I used this list to locate his first paper, published 50 years ago, on variation in the butterfly *Heodes phlaeas*. Here is manifested the meticulous care and the sure style of the years to come. The young author adduces 50 pages of data and grapples with the prevailing ideas—particularly those of Weismann.

Three of the essays seem to me to be outstanding. One is on plant evolution in extreme environments by A. D. Bradshaw (whose name is missing from the "list of contributors"). After reading this beautifully wrought paper, I conclude that microevolutionary adaptation in plants deserves far more attention than it has had. The paper "Drug therapy as an aspect of ecological genetics" by D. A. P. Evans is full of new perspectives for those interested in the seemingly disparate subjects of pharmacology and population genetics. Finally, I was captivated by Miriam Rothschild's essay "Speculations about mimicry with Henry Ford." The pursuit of knowledge by generations of British naturalists (Gilbert White, Charles Darwin, William Henry Hudson) has been traditionally unfettered by the seductions of applied science. With charm and humor, Rothschild articulates the sheer delights of the intellectual adventure, the "Fragestellung," which is, indeed, characteristic of the Fordian approach to nature.

HAMPTON L. CARSON
Department of Genetics,
University of Hawaii, Honolulu

A Symbiosis

Gardening Ants, the Attines. NEAL A. WEBER. American Philosophical Society, Philadelphia, 1972. xx, 146 pp., illus. $8. Memoirs of the American Philosophical Society, vol. 92.

Long files of ants carrying fragments of leaves over their heads impress visitors to tropical and subtropical America. These "leaf-cutting ants" carry the fragments back to their subterranean nests to provide a substrate for a fungus which grows in large masses in nest chambers. The fungus in turn provides nourishment for the developing ant brood and adults of the colony. About 200 species of ants, constituting the tribe Attini, are known to culture fungi, mainly on insect excrement or dead plant materials. The common name "fungus-growing ants" has been universally applied to attines. Now, Neal Weber has rechristened them "gardening ants," a term fully as descriptive but hardly necessary.

In a personalized account Weber describes the results of a more-than-35-year romance with fungus-growing ants, a subject for which he clearly has preeminence. The nine chapters treat the main aspects of attine structure and biology including the life cycle, colony populations, nest structure, foraging behavior, and fungus gardens. An appendix provides a key to attine genera and records of the distribution of species occurring north of South America, mating flights, and guests, parasites, and predators.

Does each species of ant harbor a different species of fungus? Apparently not. Weber describes his pioneering efforts in developing culture methods to raise the fruiting bodies necessary for the identification of fungi. Only one fungus has so far been identified, but the magnitude of the task makes even that achievement significant. In contrast to the extensive description of studies of fungal culturing, Weber devotes less than half a page to the evolution of fungus-growing, a subject deserving more extensive explanation. Concerning the related question of the phylogenetic origin of Attini, Weber briefly mentions that they closely resemble the harvester ant genus *Pheidole*, a suggestion made nearly 80 years ago by von Ihering. No mention is made of von Ihering or of how attines resemble *Pheidole*.

The book is well illustrated; however, several figures are out of sequence and the captions of several others are misleading. Four tables lack titles. The list of species in the appendix would have been more valuable had it included those living in South America, where the majority of attines occur.

Weber has provided us with a comprehensive review of the literature and a wealth of heretofore unpublished observations. His book should become a primer for those intent on investigating the symbiotic association of ants with fungi.

PAUL B. KANNOWSKI
Department of Biology,
University of North Dakota,
Grand Forks

Anniversary Assessment

Insulin Action. Proceedings of a symposium, Toronto, Oct. 1971. IRVING B. FRITZ, Ed. Academic Press, New York, 1972. xx, 610 pp., illus. $17.50.

In commemoration of the discovery that the lives of depancreatized dogs and, indeed, the lives of patients with diabetes mellitus could be sustained by injections of pancreatic extracts, several international symposia were held during the 50th anniversary year. This book presents the proceedings of a symposium held in Toronto, scene of the historic discoveries of Banting and Best in 1921. As is implied by the title, the organizers of the symposium selected topics relating to the mechanism of action of the hormone and did not attempt to review all of the many scientific accomplishments that were sparked by the discovery of insulin. Thus the historic experiments that led to the elucidation of the primary structure of insulin, the equally historic achievement of the chemical synthesis of insulin, and current concepts of the use of insulin in the treatment of human disease are not considered. This is a commendable restriction in the scope of the symposium but limits the value of the book to medical historians and to the many researchers in the field of insulin action.

As with other symposium proceedings, many of the data have been published elsewhere in greater detail. Nevertheless, it is convenient to have them reviewed and summarized under a single cover. The initial chapters are concerned with the three-dimensional structure of the insulin crystal, and with the structure-activity relations of

insulin in solution. There are several chapters dealing with insulin-receptor interactions and the metabolic events affected by the activated receptor. The final section consists of an analysis of the actions of insulin on the metabolism of glycogen, lipids, and protein. It is probable that the most important recent developments in the field have emanated from the laboratory of Cuatrecasas. His contribution is an informative summary of his outstanding work on the identification and characterization of the insulin receptor.

Clearly the greatest strength of this volume lies in the 90 pages of questions and answers. This was a small symposium and it appears that the discussion was lively. It was recorded and skillfully edited by Fritz. This exchange of ideas among many of the established investigators in the field is informative and interesting and of a sort not available in standard scientific journals.

Aside from the repetitious nature of many of the data, there are two other features of this book that are unattractive. First, in contrast to the other contributions, that by Cuatrecasas is written with a distracting lack of modesty. It would appear that the concept of a peptide hormone receptor, the experimental approach used in studying the properties of receptors, and virtually all of the relevant work in the field are due to the author and his colleagues. In the opinion of this reviewer such is not the case. Second, the chairman at one or two points attempts to direct the course of the discussion by emphasizing areas of disagreement between the participants. Although it is obvious that differences need to be resolved, this is usually achieved by a systematic and impersonal study of the published data rather than by having "a hot exchange" during the discussion period. The latter is entertaining for the audience but, in general, scientifically unproductive.

The book is a valuable collection of data and opinions which document the status of our understanding of the mechanism of the action of insulin 50 years after its discovery. Every scientific library and every insulinologist should have a copy.

OSCAR B. CROFFORD
Departments of Medicine and
Physiology, Vanderbilt University School of Medicine,
Nashville, Tennessee

Matters of Technique

Electron Microscopy in Material Science. A NATO Advanced Study Institute, Erice, Italy, Apr. 1971. U. VALDRÈ, Ed. Academic Press, New York, 1971. xxiv, 758 pp., illus. $35.

Electron Microscopy and Structure of Materials. A symposium, Berkeley, Calif., Sept. 1971. GARETH THOMAS, RICHARD M. FULRATH, and ROBERT M. FISHER, Eds. University of California Press, Berkeley, 1972. xiv, 1292 pp., illus. $28.50.

Electron Microscopy in Material Science contains a collection of lectures, presumably since expanded, given by 18 contributors at the 1970 International School of Electron Microscopy. Unfortunately, some of the chapters, such as those on the transfer of image information and phase contrast, appear to be written by experts for experts and fall short of the first objective of the school: "to bring scientists up to date with a refresher course on the latest developments in conventional and nonconventional electron microscopy." The experts will be pleased to find conveniently accessible, in English, and handled in a masterly fashion with good illustration, much of the advanced information scattered in the literature.

Goringe aptly points out in his chapter on computing methods that half the information available in the electron microscope beam is usually lost in the recording process, where phase relationships are removed and only intensities recorded. Since lattice fringe images use the phase relationships to provide information, it was surprising to find only one page in the book on this subject and this in a chapter on typical problems in electron microscopy with worked examples, written by Goringe and Hall. Other forms of phase contrast are extensively covered.

The book is perhaps at its best when it gets down to the experimental level, as in Brown's candid comments, in his very readable chapter on metallurgical information from electron micrographs, on the measurement of particle size in the case of oxide dispersions in copper and on the pitfalls thereof. As those of us who have built and operated special specimen stages for the electron microscope well know, there is much wizardry involved. The chapter on special electron microscope stages by Valdrè and Goringe is valuable.

Crewe's account of high intensity electron sources and scanning electron microscopy and his comments on the possibility of resolving atoms make interesting reading in the light of his subsequent success. For those of us without high intensity sources, image intensification is of considerable interest, and the authoritative account of the status of development in Siemens A.G. Laboratories by Hermann *et al.* is welcome.

The vital role of electron microscopy in the study of radiation damage emphasized by Hirsch in his stimulating opening lecture is brought out fully in the capable review by Makin. Castaing's chapter on secondary ion microanalysis and energy-selecting electron microscopy is a comprehensive account of his own work and that of his students and reflects their important contributions.

The second purpose of the school, namely, to favor contacts between instrument designers, experts in electron diffraction and contrast theory, and users of electron microscopes, accounts for the inclusion of comprehensive chapters on geometrical optics and problems therein by Septier and on the theory and application of electron diffraction to image contrast by Howie and Gevers.

The third purpose of the school and thus presumably of the book was "to stimulate discussions on specialized topics which are likely to bring fundamental improvements in electron microscopy." No account of any Erice discussions is given in the book and it hardly seems likely that the book will stir up any great discussions, particularly two years after the conference.

Many of the papers are tough. Though the ordinary research worker will be able to make use of them, this is not a book he will be able or will want to read from cover to cover, and few will want to pay the additional cost of much that they will never use. This suggests that it would have been more appropriate to publish the proceedings as three small (cheap?) books covering electron optics and instrumentation, diffraction contrast and applications, and transfer of image information and phase contrast, respectively. The absence of an index is deplorable.

Electron Microscopy and Structure of Materials consists of photographically reproduced typescripts of papers that were presented at a 1971 symposium, together with discussion. The papers are typically ten pages in length, with a few longer, which makes for a very large book. Fortunately, here both subject and author indexes are provided.