Kurt Mühlethaler then summarizes present interpretations of the "Ultrastructure of Plastids" (including proplastids, amyloplasts, proteinoplasts, chromoplasts and so on, as well as chloroplasts) providing a very useful picture of the structural framework to which the remaining articles may be related. This is followed by Frank Mayers's account of "Light-Induced Chloroplast Contraction and Movement", a welcome inclusion, containing a surprising wealth of information, on a topic which has defied all but the most stoic investigators since the first observations in 1850.

Two articles, one by Björn Walles on "Plastid Inheritance and Mutations", the other by Christopher Woodcock and Lawrence Bogorad on "Nucleic Acids and Information Processing in Chloroplasts", are so comprehensive and useful that they will undoubtedly sell this volume in their own right to workers in these areas. Similarly there are few investigators in my own general field who could resist the appropriate juxtaposition of Mordhay Avron on "The Biochemistry of Photophosphorylation" and Martin Gibbs on "Carbohydrate Metabolism by Chloroplasts". The article by Avron is excellent but regrettably short. Avron is a leading exponent of the view that experiment is better than conjecture and, at this stage in the elucidation of the relationship between electron transport and phosphorylation, this view can only be endorsed. Opinions based on Avron's formidable experimental experience, however, are always invaluable and on this occasion his otherwise admirable reticence is the reader's loss. The article by Gibbs covers the ground with customary authority and includes valuable comments on the present convolutions of "C4 photosynthesis" and also on the transport of metabolites between chloroplast and cell.

In recent years Andrew Benson's name (formerly linked with that of Calvin and the path of carbon) has become increasingly associated with chloroplast lipids and his chapter on this subject is consistent with his high standing in this field.

Trevor Goodwin concludes the book with a *tour de force* on "Biosynthesis by Chloroplasts". This includes sections on protein synthesis and lipids which complement those by Walles, Woodcock and Bogorad and Benson and leads naturally to the chloroplast pigments and to the study of terpenoids to which Goodwin has contributed so much.

Within the limits which it defines this book achieves virtually all that it sets out to do. One of its strengths is that it will not only give the specialist articles of the highest standard but will also provide, between the same covers, the immediately relevant background information which will allow him to start to build a picture of the chloroplast as a whole.

D. A. WALKER

Diversity of Plants

Plant Speciation. By Verne Grant. Pp. x+435. (Columbia University: New York and London, August 1971.) £7.25.

UNTIL comparatively recently, there was a tendency to divorce discussions of the phenotypic course of evolution from considerations of its underlying mechanisms. The first was largely the province of the taxonomist and palaeontologist while the second received attention from more genetically inclined investigators of two kinds—those principally concerned with the consequences of selection and those more interested in the processes of heredity. The first of these genetical approaches, frequently adopted by zoologists, was characterized by considerations of gene frequencies, major gene polymorphisms and, at least, quadratic equations. The second attitude, more often favoured by plant geneticists, was expressed in discussions of breeding systems and chromosome mechanisms.

The content and approach of this book can be viewed in these terms. But the author's previous experience as a geneticist at the Rancho Ana Botanic Garden and Director of the Boyce Thompson Arboretum puts him in an admirable position to combine the attitudes of taxonomy and genetics. Further, his wide experience and detailed investigations of *Gilia* contribute considerably to the qualities seen in the present book which is intended to be complementary to his earlier work, *The Origin of Adaptation.*

There is little in *Plant Speciation* of which one can complain but it includes the use of the word "clone" to describe the products of uniparental reproduction whether these are produced asexually or by self-fertilization and the mistaken view that intergenomic pairing (that is allosyndesis, in my opinion) is synonymous with heterogenetic pairing. By inference the author would presumably equate intragenomic pairing (that is autosyndesis) with homogenetic pairing which is clearly a nonsense. The one set of terms refers to chromosome homology (or homoeology), the other to genic relations.

It is also unfortunate that the term incompatibility is used in relation to both crossibility barriers between mating groups and mechanisms which impede or prevent inbreeding (for example, self-incompatibility) within them. Clearly, these two phenomena are quite distinct; members of separate mating groups are isolated by their differences but members of the same group are prohibited from direct gene exchange by their similarities.

There is also some tendency towards inconsistency between various ideas expressed in the book. For example, it is claimed (page 121) that the two forms of sympatric genetic differentiation (intra-specific polymorphism and species differences) differ qualitatively in that the former is "segregational variation" while the latter involves "complex gene combinations". Yet elsewhere (for example, on pages 65 and 175) the author stresses that "species often differ allelically with respect to linked morphological and viability genes" and attention is expectedly paid to semi-species. Admittedly, there are clear examples of qualitative differences between the two variation patterns, for a sexual dimorphism can no more constitute a species difference than a polyploid series can compose an intraspecific polymorphism—except as a taxonomic artefact. But the significant difference between the two patterns of sympatric variation is neither quantitative nor qualitative but functional (compare incompatibility above). Differences between morphs, by creating a mutual dependence, are a means of maintaining the integrity of a mating group while those between species create competition and interrupt the genetic continuum. The inevitable qualitative difference between the two states is that the former unavoidably involves a balance between often-favoured heterozygotes and one or more homozygotes while the latter generally consists of two or more alternative homozygous states at the (chromosome level) with selections acting against the hybrids and/or the means of producing them.

The standard of illustration is high but there are disappointingly few tables. The general treatment, however, is well balanced, the information is presented in an orderly manner and the material is generously discussed. The book, in fact, represents a useful contribution in an area of enquiry shared by population geneticists, taxonomists and natural historians.

K. R. LEWIS

Biological Cybernetics

Information and Control in the Living Organism. By Bernhard Hassenstein. Pp. viii+159. (Chapman and Hall: London, December 1971.) £1.30.

THIS elementary introduction to biological cybernetics by the well-known zoologist of Freiburg University might well be the best way to arouse the interest of young biologists in general cybernetics. Books on this subject are often in forbidding mathematical langu-