Howe and Westley's chapter on the ecology of pollination and seed dispersal, to show the types of flowers and fruit associated with each syndrome.

The chapters on physiological ecology by Mooney, Fitter, and Crawley set out clear definitions and mechanisms for many central ideas of plant population biology, such as allocation patterns, life history strategies, and reproductive effort. The physiological basis of plant growth patterns is described in relation to limiting resources. The common technique of measuring reproductive effort as the percentage of total plant weight accounted for by reproductive tissue is seen as providing only a crude approximation, in part because the green parts of reproductive tissue contribute a substantial portion to their own carbon budget.

The chapter by Levin on breeding systems and genetic variation is a good summary of a rapidly developing branch of population biology, in which Levin himself has been influential. In the last 20 years electrophoretic analyses have shown that outcrossing species generally have greater genetic variation than selfing species in terms of the percentage of loci that are polymorphic, the number of alleles per polymorphic locus, and the percentage of polymorphic loci that are heterozygous. Further, selfing species have a greater proportion of their genetic variation distributed among populations than do outcrossing species.

The chapter by Waller demonstrates the renewed importance of classical plant morphology and anatomy in explaining the constraints on plant development. Plants are typically constructed out of modular units, such as leaves, shoots, and roots, with the placement of these structures as well as of dormant buds governed by morphological rules. Computer models using these rules can predict how plants would grow to maximize photosynthesis in the absence of competitors and how they would grow to maximize survival in the presence of intense competition. These models are proving to be extremely useful in predicting the ecological consequences of the branching patterns found in early land plants as well as the adaptations of herbaceous plants in different environments.

Other chapters are more narrowly focused. For example, Hubbell and Foster primarily describe their own studies of long-term changes in tropical tree populations. These studies have shown that, though only a few of the species have specialized requirements for regeneration, most can establish new recruits equally well in the range of canopy and gap environments occurring in the forest.

The chapter by Gill presents arguments for a controversial theory. Gill believes that somatic mutations may allow long-lived plants, such as trees and rhizomatous perennial herbs, to generate the genetic variability needed to respond to herbivore attack and other aspects of a changing environment. His evidence comes primarily from the literature of agriculture and horticulture in which somatic mutants spontaneously appear and are preserved if economically useful. Also he describes the variability among the branches of naturally occurring woody plants in fruit production and herbivore damage as examples of possible somatic mutation. The proof of this thought-provoking theory will come after careful, controlled experiments have been conducted using isozyme, chromosome, and quantitative genetic studies.

As with any compilation, some topics are covered only superficially or omitted in this one—for example vegetation analysis, herbivory, and biochemical ecology. The book is of excellent quality, however, and is recommended for anyone wanting a current overview of plant population biology.

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Palynological Patterns

Pollen and Spores. Form and Function. S. BLACKMORE and I. K. FERGUSON, Eds. Academic Press, Orlando, FL, 1986. xvi, 443 pp., illus. $92.50. Linnean Society Symposium Series, no. 12. From a symposium, London, March 1985.

Research on modern and fossil pollen and spores has contributed greatly to ideas about the evolution and relationships of plant groups. The study of functional factors underlying the intricate and bewilderingly diverse variations in pollen form and exine structure has lagged behind, however, despite its potential for raising pollen morphology above the descriptive level and for elucidating the biology of ancient plants through inferences from the fossil pollen record. The present volume consists of papers presented at a symposium that was intended to improve this situation.

The success of the symposium was limited by the fact that very few people have specialized in the functional morphology of pollen, so most of the contributors are experts on other subjects. Some deal with this problem by writing on other topics (sometimes with important results, such as the conclusion of Walker and Walker that the initial Cretaceous radiation of monocots was centered in Laurasia rather than in northern Gondwana, as has been inferred for dicots). Many who do consider function tend to ignore recent critiques of the "adaptionist program," particularly of its tendency to accept the first plausible explanation for a feature without considering how it might be tested against alternative hypotheses, including explanations based not on function but rather on phylogenetic, developmental, or geometric constraints. These latter issues are addressed most explicitly by Blackmore and Barnes, who argue that mechanisms for harmomegathy (which allow pollen to accommodate changes in volume during release and germination) are generally exaptations that arose by co-optation of features that originated as adaptations for protection or germination, and by Kress, who maintains that since the "exineless" condition in Zingiberales is primitive in the order as a whole, studies of function in modern members may not reveal why it originated in the first place. The several papers on development are most valuable in summarizing the great strides being made toward recognition of common mechanisms behind seemingly unrelated patterns of exine development, but they are also significant in pointing out the role of structures as routes for exchange of materials or foci of exine deposition during development and suggesting that some structures may have little to do with survival value at the stage when pollen is actually functioning.

One of the papers of broadest interest is Crane's review of pollen morphology in relation to wind pollination, which covers the wide range of factors (physiological, mechanical, aerodynamic) involved at all stages in the process. However, it skirts some major questions, such as the reason for the shift to granular exine structure in Amentiferae and whether the sacs in conifer pollen function primarily for buoyancy during transport or flotation in the pollen chamber. In general, the best-understood aspect of pollen function, elegantly illustrated by the paper by Blackmore and Barnes, seems to be harmomegathy, which is easiest to investigate experimentally. There has been less progress toward explaining variations in exine structure in functional terms, perhaps because exine biomechanics is less amenable to experimental or mathematical analysis. Several papers relate exine characters to climate or pollinators, but these tend to be based more on correlation arguments than on analysis of causal factors, raising the possibility of spurious secondary correlations. The most successful of these studies is that of Grayum, who correlates evolution of secondarily smooth and spinose exines in Araceae with specialization for beetle and fly pollination.

If one is looking for a definitive synthesis

of functional pollen morphology, this book may be disappointing. However, it samples some of the most dynamic current trends in palynology, and it contains enough ideas and reviews of previous work to serve as a valuable stimulus for more focused studies.

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Ramifications in Physics

The Quantum Universe. TONY HEY and PATRICK WALTERS. Cambridge University Press, New York, 1987. viii, 180 pp., illus. $47.50; paper, $16.95.

Two major revolutions in the basic ideas of physics have taken place in this century: the theory of relativity and quantum theory. Both have far-reaching philosophical, theoretical, experimental, and practical implications. Of the two, however, quantum theory is the more pervasive in terms of the variety of phenomena it allows us to understand. It is also the more discomforting to our intuition because it uses apparently contradictory concepts, such as wave and particle, to treat the same objects and because it renounces the sort of determinism we naively expect in a physical science. Hey and Walters have set themselves the task of explaining the physics (but not the philosophy) of quantum theory, together with its application to a broad range of phenomena, to people who are not physicists and who have a limited knowledge of mathematics. Although the Dirac equation (with symbols undefined) does appear, the equations that the authors use are mainly at the level of $I_{12} = (h_1 + h_2)^2$ for the intensity I_{12} of two waves of amplitudes h_1 and h_2.

The authors emphasize two main aspects of quantum theory: the wave nature of particles and the Pauli exclusion principle. They explain interference through a detailed discussion of the double-slit experiment for electron waves, including the situation in which the interference pattern is destroyed by the observation of which slit the electron traversed. They use the wave picture to explain interference effects for electrons and other particles, the Heisenberg uncertainty principle, quantum barrier penetration or tunneling, the quantization of the energy of a bound particle, and quantum coherence, among other phenomena. I particularly liked the illustration of tunneling with photographs of water waves being stopped by a barrier but being transmitted with reduced intensity when the barrier thickness is decreased. The authors use the Pauli principle, that only one electron, proton, neutron, or other "fermion" can occupy a given quantum state, to provide an understanding of the periodic table of the elements, chemical bonds, the electrical conductivity of metals, semiconductors, and insulators, and the evolution of stars. They also discuss the tendency of "bosons," such as the "photon" (or quantum of light) and pairs of electrons (such as the "Cooper" pairs, which play a crucial role in the theory of superconductivity) to be in the same quantum state (a sort of opposite to the Pauli principle). They apply Bose statistics to lasers, superfluid helium, and superconductivity.

Hey and Walters show how the wave picture, the Pauli principle, and Bose statistics provide qualitative explanations of a wide range of phenomena of pure physics, from quarks in the small to various types of stars (normal stars like the sun and exotic stars like white dwarfs, neutron stars, and black holes) in the large. They also demonstrate the applicability of quantum ideas to phenomena ranging from the solidity of everyday objects like chairs to the "high technology" of lasers, Josephson junctions, and field-emission microscopes. The variety of the topics discussed reflects the throughgoing way in which quantum ideas have illuminated our understanding of nature.

The book is copiously illustrated with photographs and diagrams, many in color, of objects in the physical world, of physicists, of equipment, and of experiments. It is written in a clear and engaging style. Hey and Walters have given us a digestible quantum feast. Their book is a pleasure to both the mind and eye.

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Some Other Books of Interest

Lasers. Invention to Application. JESSE H. AUSUBEL and H. DALE LANGFORD, Eds. National Academy Press, Washington, DC, 1987. viii, 134 pp., illus., + plates. Paper, $14.95. From a symposium, 1985.

Among the gatherings held in 1985 to celebrate the 25th anniversary of the invention of the laser was a symposium sponsored by the National Academy of Engineering. The present volume, stemming from that symposium, is an attempt to "bring the excitement and intensity of the laser story to a broader audience." The opening chapter, by Anthony E. Siegman of Stanford University, gives a broad overview of the subject, including the history, characteristics, types, and present and possible future applications of lasers. Anthony J. DeMaria of United Technologies Research Center and Rensselaer Polytechnic Institute then discusses the industrial use of laser technology, including economic data as well as accounts of several particular applications. In the next chapter, the longest in the book, C. Kumar N. Patel of Bell Laboratories reviews the uses of lasers in communications and information processing.

Medical uses of lasers are summarized by Rodney Perkins, a surgeon with both research and business interests in the field. In two final chapters Arthur Schawlow of Stanford (sharer of a Nobel Prize for his work in developing laser spectroscopy) describes some uses of lasers in scientific research and John R. Whinnery of the Univerity of California at Berkeley discusses the contributions of science and engineering in laser development. All the contributors express optimism about the future of laser technology, though DeMaria points to a shortage of appropriately trained engineers as a potentially serious problem. The volume includes a glossary and several color plates. —K.L.

Current Topics in AIDS. Vol. 1. M. S. GOTTLIEB, D. J. JEFFRIES, D. MILDVAN, A. J. PINCHING, T. C. QUINN, and R. A. WEISS, Eds. Wiley-Interscience, New York, 1987. xii, 313 pp., illus. $49.95.

This volume, the first in what is intended to be a regular series, is an attempt to fill "a need for authoritative review articles by active investigators who could take a wide perspective on their specific area" of AIDS research. According to the editors they have tried to select topics that have not been extensively covered elsewhere and that are of particular current interest or warrant review because of a large accumulation of data. The volume contains 14 papers by 29 contributors from the United States and Britain. It opens and closes with papers on the broader aspects of the subject, including policy perspectives, epidemiology, the range of clinical manifestations, the natural history of infection with the AIDS virus, the disease as manifested in Africa, and its psychosocial impact. The intervening chapters deal with subjects of laboratory or clinical study: the causative virus and its kin, immunopathogenesis, serological tests, gastrointestinal manifestations, infections in infants and children, T cell phenotyping in diagnosis and management, effects on the central nervous system, and clinical manifestations as yet unstudied scientifically. A subject index is included.—K.L.