plications of mathematics to biology. The contributions of this sort vary widely in scope; T. L. Hill introduces a model of the steady state kinetics of a linear array of subunits (for example, enzymes), H. L. Frisch, M. Bishop, and J. Roth apply Monte Carlo methods to self-replicating macromolecules, L. Glass considers the dynamics of biological systems using the ideas of statistical mechanics and nonlinear differential equations, and R. M. Wartell deals with a biological "phase transition," the DNA helix-coil transition.

A number of unusual contributions fall in the category of applications of statistics. R. Herman and Montroll look at a 75-year run of Sears Roebuck catalogs in an endeavor to throw light on mechanisms of market dynamics. T. R. Smith devotes his attention to the commercial banking system of New York City in the 1850's, looking for a basis for explaining events that led to the crisis of 1857. G. F. Newell discusses the fluctuations of timing on bus trips and explains why buses so readily fall behind schedule. G. H. Weiss and R. A. Brooks describe the development of computer-assisted tomography for improving x-ray images and discuss the errors involved. More formally, M. D. Srinivas and E. Wolf consider the treatment of quantum mechanics as a stochastic process in phase space.

Finally there are the miscellaneous contributions. B. B. Mandelbrot discusses his ideas on fractal geometry and describes the remarkable way in which he has made practical use of the abstract mathematical concept of Hausdorff dimension. F. T. Hioe advocates the use of determinants and their expansions in a number of physical problems. M. Dresden speculates on the use of random considerations in particle physics. In considering the properties of the ballast resistor, D. Bedeaux, P. Mazur, and R. A. Pasmanter are led to solitary wave solutions of this nonlinear system. J. B. Keller formulates a general theory of the effective macroscopic behavior of a medium that exhibits microscopic heterogeneity. M. Ruderman writes of exotic and unfamiliar forms of matter that may play an important role in astrophysical phenomena. V. Khare and H. M. Nussenzveig review various theories of the glory—the appearance on a mountain peak under suitable atmospheric conditions of a human shadow with a halo around the head.

It is fascinating to see mathematics applied successfully to such a wide spectrum of real-world problems. The volume is indeed an appropriate tribute to Elliott Montroll, for many of the contributions are consequences of his own initiative. Any mathematician looking for a practical outlet for his or her talents will surely find something of interest in this volume.

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Fungal Mitoses

Nuclear Division in the Fungi. Papers from a symposium, Tampa, Fla., Sept. 1977. I. BRENT HEATH, Ed. Academic Press, New York, 1978. xii, 236 pp., illus. $16.

The small size and poor staining properties of their nuclei and chromosomes previously ensured that nuclear division was one of the least known or understood aspects of the fungi. Since about 1960 the innovatory light-microscopic studies of Robinow and the electron-microscopic study of serial sections pioneered by Girbardt have quite dramatically revealed a wealth of new details and an astonishing diversity of nonclassical behavior.

This book, an expanded record of a four-person symposium, describes modern developments. It is well worth reading by cytologist, mycologist, and general biologist alike. Despite its title, the work is concerned almost entirely with ultrastructural aspects of mitosis, so that data on and issues arising from the remarkable contrast between such unusual divisions and the apparently conservative, meiotic behavior of fungi are omitted: a pity. The book does provide a valuable and unique record of current studies of mitosis in fungi. Quite incidentally, it also reveals that two major constraints in this field are the few species of fungus studied and a dearth of investigators.

Heath's chapter, an excellent, comprehensive précis of published work on ultrastructural aspects of mitosis in fungi embellished by original unpublished observations, is central to the book. It is valuable for its factual coverage, for propounding controversial and speculative ideas, and for highlighting existing areas of obscurity. More issues remain unresolved than are resolved. What, for example, is the significance of the diversity of nuclear-associated organelles (spindle-pole bodies), of the diversity of spindle origination, organization, and function, of the relative infrequency of metaphase plates, or of the not infrequent loss of the nucleolus and much of the nucleoplasm to the cytoplasm? Many such topics are taken up by Kubai, who makes fascinating comparisons between different fungi and between fungi and algae or other protists. Are the similarities the result of convergent evolution or of common ancestry? Are the differences reflections of function or of phylogeny?

Girbardt's valuable introduction proposes a series of cyclical phases for nuclear-associated organelles and touches on the relationship between light- and electron-microscopic images. Such comparisons are, unfortunately, made rarely by the other contributors even though, for example, it is evident that the characteristic preanaphase "double-track" appearance of fungal cells cannot yet be interpreted satisfactorily by ultrastructural observations (despite Heath's ingenious suggestions). A chapter by Forer on the possible role of actin filaments in chromosome movement is provocative but is only tenuously related to the other contributions.

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Dentition

Development, Function and Evolution of Teeth. Papers from a symposium, Cambridge, England, Sept. 1974. P. M. BUTLER and K. A. JOYSEY, Eds. Academic Press, New York, 1978. xx, 524 pp., illus. $55.75.

A wealth of information about mammals is stored in their teeth. No other anatomical system records the combination of genetic, developmental, adaptational, and demographic evidence that teeth do. The hardness and density of dental enamel have caused teeth to be abundantly preserved in the fossil record, giving mammals a detailed evolutionary history unsurpassed in any other group of organisms. Hence a large amount of research is devoted to gaining a better understanding of teeth. To further interdisciplinary communication on the subject several international symposia have been held since 1965. The book reviewed here comprises the revised and updated contributions to a 1974 symposium in the series. The proceedings of the 1965 and 1968 symposiums were important in furthering understanding of dental morphology, and this well-produced new volume records another significant advance.

The 32 chapters of the book cover tooth morphogenesis, internal structure,

external form and its genetic basis, sexual dimorphism, pathology, evolution, dietary adaptation, jaw muscles and mastication, occlusion, nomenclature, attrition, and demography. The contributions, with a few exceptions, are well written and well illustrated, and each covers a broad field of current interest.

Among the most interesting are papers by Moss-Salentijn on vestigial teeth in rabbits, rats, and mice, by A. Boyde on the structure of incisor enamel in rodents, and by M. L. Moss on a developmental basis for sexual dimorphism in human canine teeth. J. W. Osborn presents a clear and well-reasoned paper on morphogenetic gradients in the mammalian dentition, interpreting these as developing from self-generating "clones" rather than complex externally controlled "fields." However, his paper ends with a disturbing discussion of tooth homologies that emphasizes developmental simplicity to the exclusion of other adaptive and evolutionary possibilities. In view of the remarkable dental changes that have been documented paleontologically, I suspect that developmental mechanisms may be more complex than Osborn implies, and his suggested revisions of tooth homologies must be tested against the fossil record before they are accepted.

A. W. Crompton and Kielan-Jaworowska review molar structure and occlusion in Cretaceous therian mammals, indicating that metatherians may have had an American origin, whereas most or all eutherians entered North America from Asia in the late Cretaceous. R. F. Kay analyzes molar structure and its correlation with diet in cercopithecoid primates. G. H. R. von Koenigswald gives a brief discussion of the palate of "*Pithecanthropus* IV," dated at 1.9 million years from the Djetis beds of Java.

The longest paper in the book is a review of mammalian mastication by K. M. Hiiemae summarizing the great advances of the past ten years in understanding how the masticatory system as a whole functions. Much remains to be done in reconciling data from occlusal (wear facet) analysis with jaw movements and electromyographic records of muscle activity, as Hiiemae notes, but her review is a welcome summary of what has been learned to date about mastication. Also of general interest are a chapter by Rensberger documenting a variety of different types of tooth wear correlated with different diets in rodents and a conservative chapter by Butler on tooth nomenclature.

In summary, this book gives a valuable overview of current research on the development, adaptations, and evolution of mammalian teeth. In view of the rapidity with which the field is developing, one hopes that this symposium will be followed by more such symposiums.

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