genetic drift, migration, and mutation, all operate to alter the genetic constitution of a population and together comprise the evolutionary process. Hedrick discusses in some detail the effect of these forces, both separately and together, on the change of gene frequencies at single loci within and between populations, and illustrates the theoretical treatment with relevant examples from the recent liteature. This is followed by a discussion of the extension of population genetics models based on segregation at a single locus to models of variation at two or more loci considered jointly, including an introduction to quantitative genetic theory. The final chapters of the text cover molecular evolution, topics at the interface of population genetics and evolutionary theory, and human population genetics.

Features of this text which enhance its value as a teaching tool are the blending of theory and empirical observation throughout, problems of varying degrees of difficulty at the end of each chapter, and sample computer programmes for the simulation of evolution for a few of the models discussed in the text. Although the approach adopted is necessarily rigorous, understanding of the majority of the concepts discussed requires no more than a knowledge of elementary algebra. I would recommend Hedrick's text to serious students of population genetics, and also as a useful reference to research workers in the field.

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Microbial Development. Edited by RICHARD LOSICK and LUCY SHAPIRO. New York: Cold Spring Harbor Laboratory. 1984. 303 pages. Paperback $28.00 ($33.60 outside U.S.), hardback $52.00 ($62.40 outside U.S.). ISBN 0 87969 173 5.

This monograph is based on a Cold Spring Harbor meeting on the same theme, and has been converted by editors and contributors into an excellent review volume, brought up-to-date during the year since the meeting was held. Many geneticists will find a great deal that is new in it, and it will be of particular value to those who believe that only eukaryotes present any interesting and difficult developmental problems to the molecular geneticist. Only three of the eleven chapters deal with microbial eukaryotes (specifically yeast and *Dictyostelium*), and the rest bring out the variety and sophistication of developmental systems that are under detailed study in bacteria.

Taking simple binary fission first, *Escherichia coli* has a straightforward growth cycle of cell elongation, symmetrical septum formation and cell division, but this requires the coordinated action of some 45 different genes with no other apparent primary role in cell metabolism. The bacterium *Caulobacter crescentus* is less well known: it alternates two distinct cell types, swarmer cells with a single polar flagellum and stalked cells derived from swarmers which have shed the flagellum and grown a rigid stalk in its place. Remarkably, DNA replication can only occur after the stalk has replaced the flagellum, and the stalked cell then develops a flagellum at the opposite end to the stalk and divides to produce a swarmer and a stalked cell; the new swarmer can then only propagate by first turning into a stalked cell. Some 40 genes have been identified as involved in this differentiation process. *Bacillus subtilis* divides by simple fission in much the same way as *E. coli* under good nutritional conditions (perhaps this also requires 30 or 40 genes, but it has not yet received the detailed and ingenious study given to *E. coli*); but under starvation conditions it produces spores by a novel developmental process which starts with the formation of a very asymmetric septum and has been shown to require the action of about 50 gene loci. The novelties found in *B. subtilis* include the presence of 5 different RNA-polymerase sigma-factors, of which one is apparently specific for transcribing many

(all?) sporulation genes – this contrasts with the single sigma factor so far identified in *E. coli*.

Streptomyces grows as a complex substrate mycelium in the soil and puts up aerial hyphae under poor conditions. These hyphae form chains of spores, helped by cannibalisation of the original mycelium and the excretion of antibiotics. These antibiotics can be reasonably described as the product of physiological differentiation, since their biosynthesis is induced by the conditions which lead to spore formation. Of particular interest is accumulating evidence that genes coding for resistance determinants to the various antibiotics are closely linked to the antibiotic production genes. Surprisingly, only 12 loci specific for sporulation in *Streptomyces* have so far been identified, but some of these may possibly consist of groups of genes.

Myxobacteria share the same ecological niche in soil, where they feed on bacteria, as the cellular slime moulds, and show a remarkable degree of parallel evolution, and the chapters on the two groups need to be read together. The myxobacteria degrade insoluble organic molecules in the soil by producing extracellular enzymes, and they have therefore developed ways of keeping their cells together in multicellular masses because of the much greater efficiency of feeding this allows on a protein substrate – they have been described as 'feeding like a pack of microbial wolves'. The development of their fruiting bodies seems also designed to produce large cell masses when the spores germinate.

The other bacterial topics dealt with are motility and chemotaxis in *E. coli*, Streptococcal sex pheromones and the developmental genetics of *Rhizobium*-Legume symbiosis. One could argue that only the last of these is strictly a developmental topic, but it is useful to have up-to-date reviews on all three subjects, written with developmental aspects in mind. The eukaryotic microbes are covered by excellent articles on development in *Dictyostelium* and yeast. In the case of the former, growing cells contain about 4500 discrete mRNA species, and these are joined by 2500 to 3000 new species of mRNA at the time of formation of cellular aggregates – this brings out the much greater complexity of the *Dictyostelium* genome than those of the prokaryotes mentioned above, which could muster less than half as many mRNA species. I would have welcomed a comparable article on the acellular slime mould, *Physarum*, which was included in the Cold Spring Harbor meeting but omitted from this volume. It has several times as large a genome as *Dictyostelium*, and an intriguingly different life history (Students of *Physarum* have described *Dictyostelium* as a 'fake' slime mould, e.g. H. W. Sauer in his book 'Developmental Biology of *Physarum*,' Cambridge University Press, 1982, which is an excellent study of this organism, though not up-to-date on its genetics).

The new techniques of molecular genetics have already made important contributions to the many developmental topics discussed in this monograph. I think it will widen the horizons of most readers, and it deserves a place in every library where geneticists may browse. It may well encourage some of them to join the small bands of enthusiastic research workers that one of the authors refers to.

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Mutations in Man. Edited by G. OBE. Berlin: Springer-Verlag. 1984. 327 pages. DM116. U.S. $45.50. ISBN 3 540 13113 2.

To date there has been no unambiguous demonstration of the induction of human germ-line mutations and, until it has been demonstrated, there will continue to be uncertainty over the reality of the risk to the human germ cells from environmental mutagens. However, somatic cell mutations are induced in human cells and the link between mutagenesis and carcinogenesis is firmly established. If only for this reason it