of the scientific world view and its ultimate use to facilitate the expansion of power. If the alchemists had succeeded in tapping mystical powers by wringing gold out of lead and tin, the world would indeed have been different.

The villain, then, is culture, our culture. Mowshowitz finds in the acceptance of the scientific view the ultimate conquest of human will:

> Most of the stories we have cited, bear witness . . . to an inherent contradiction in the conquering spirit of science and technology. The conquest of nature, space, and time is seen as a paradoxical victory over the human ego. As man extended his dominion over the natural world, he became alienated from the sources of his vitality. Through obsessive exercise of the will to power in the elaboration of technique, the will itself became enfeebled and subject to control by autonomous forces linked to mechanical progress. . . . This procedure has its counterpart in the evolution of industrial technology and social organization. In both cases, it is reflected in the imperative to divide and conquer [p. 313].

In the end, Mowshowitz concludes that computers in service to this ever-expanding power nexus are not inevitable but instead reflect a political and deeply seated cultural faith. They can be overcome, for "there are always other choices so long as the paralysis of will is not complete."

In point of fact the alchemists did not succeed in getting gold from baser elements whereas science did succeed in its more limited objectives. It is not manifestly apparent to me that acceptance of the scientific world view has alienated us from the "sources of our vitality" (whatever they may be). It is even less apparent to me that this medieval search for a first cause of Western cultural error explains anything about the role of technology and computers in modern society.

In fact, Mowshowitz's cultural critique leads him into some curious positions. He agrees with most that computers lead to centralization, diminution of opportunity for participation by ordinary citizens, and cavalier attitudes by administrators toward basic human dignity, the loss of which never appears as a cost in cost-benefit studies. Yet he does not explore the possibilities for altering the balance between organizational gargantuans and the individual through legislative and political means. He agrees that computers threaten individual privacy, but is critical of reform efforts in the United States which have legislated protection of confidentiality, access to government records, privacy, and due process. These efforts Mowshowitz believes actually legitimate the further operation of computer-based information systems without challenging their existence. He believes in smaller social and economic units and believes that a restriction of choices of available goods and services would result from the replacement of large units by small. Unfortunately he does not explore this possibility specifically by detailing the human costs of going backward in time. Critical of reformist efforts, Mowshowitz asks us to exercise our willpower to define new alternatives for organizing society and distributing the benefits. Unlike the counterculture school, however, he does not provide us with new myths around which we could reorganize society. Neither does he provide us with any assurance that replacing the scientific world view with another would lead to any less self-deception than now prevails. The scientific world view may be reductionist, but then again so are most world views.

In the end, instead of attacking frontally the political and corporate forces that are in fact shaping this technological world to fit their needs, Mowshowitz attacks Western culture. Whatever we may think of Western culture it is a sure bet that to change it is a much more difficult, problematic, and long-range enterprise than to change the more proximate causes of our predicament. Moreover, within Western culture are powerful nonscientific values which can be (and indeed have been) used to balance the effects of a value-free science. The notions of equity and justice, dignity and freedom, which are a part of Western heritage in religion and law have indeed been sacrificed at times to other values such as scientific rationality and efficiency. Where this has happened it has usually been a result of political decision-making, and need not be ascribed to the conquest of the human spirit.

It is then to these concrete social and political forces and groups that currently are designing the future of our society in corporate board rooms and government agencies that we must turn our attention. Is it possible to put existing computer and telecommunications technology to use in such a manner as to strike a more desirable balance between the individual and the organizations that presumably serve him? Is it conceivable that the traditional management information system which funnels information always upward can somehow operate just as efficiently in reverse for quite different reasons? How might a technology be developed that would allow citizens to discuss important issues, organize coalitions, and press home their views? What kinds of groups would support such proposals? What are the costs of developing and operating a more humanized technology? Would the public believe the costs worth the results?

The answers to these questions depend on patient empirical research, demonstration projects, and experiments by social scientists, engineers, and computer scientists working together. While such projects exist they are few and far between. In their absence Mowshowitz is surely correct in his belief that we shall be conquered by the very tools we design to liberate us.

KENNETH C. LAUDON
Center for Policy Research, New York

Issues in Population Genetics

Population Genetics and Ecology. Proceedings of a conference-workshop, Israel, March 1975. SAMUEL KARLIN and EVIATAR NEVO, Eds. Academic Press, New York, 1976. xiv, 832 pp., illus. $25.50.

Contrary to the impression the title may give, this collection of papers contains relatively little of what an ecologist would consider ecology. There is a fair amount of outdoor population genetics, some British-type ecological genetics, a number of considerations of geographically structured populations, and even reference to r and K. But only passing consideration is given to the regulation of population densities and to the interactions among populations of different species. Indeed, in only one of the many theoretical papers is the parameter N anything other than a constant. On the other hand, the collection is an excellent testimony to the diversity of approaches and concerns of contemporary evolutionary genetics. These 31 articles offer the reader a good view of where the subject is now and a preview of where it is going. Many of these papers reflect the increasing attention that both theoretical and empirical population geneticists have been giving to the realities of organisms living in natural habitats. I assume that is what motivated the editors to include the word ecology in the title.

The articles are grouped by approach rather than subject: Field and Laboratory Studies; Models and Evidence; and Theoretical Studies. Each section is preceded by remarks by the editors which summarize the articles but do not discuss them or attempt to relate them to the subject at large. Comments by other contributors are included for only a few papers. The concluding section of the volume, Problems, Objectives, and Comments, is the edited transcript of a "free-for-all"

discussion from the meeting at which the papers were first presented.

The contributors are all active and able population geneticists, and many of the papers are significant original contributions. As a collection, however, the book is rather heterogeneous. Some papers report the results of very specific recent investigations, some summarize a number of years of published and unpublished work, and a few present overviews of broad topics. The collection is welded together more by academic discipline than by common concern with specific population genetic problems.

Six of the ten empirical papers deal with variation in populations of animals and plants in their natural habitats. The studies of four anuran species by E. Nevo, of snails by Nevo and Z. Bar, and of gall-forming aphids by D. Wool and J. Koach offer correlative evidence for natural selection maintaining variation within and between populations, but give little attention to the details of the selection process. The intensive, long-term demographic-genetic studies of an island population of mice by R. J. Berry and J. Peters and of six grasses and legumes in a "grassland" biome by S. K. Jain are far more concerned with the details of the process. Jain's paper is one of the most "ecological" in the collection, and his comparative approach appears promising. These studies illustrate the complexity of the real world and thus stand as testimony to the convenience, if not the fit, of the neutral-gene hypothesis as an explanation for inter- and intrapopulation variation. J. R. G. Turner's "abstract" of the studies of butterflies of the genus *Heliconius* illustrates how the combined use of genetic analysis and ecological and geological considerations can shed light on the "unique historical process" of race and species formation.

Two of the empirical papers deal with agricultural rather than natural population phenomena. J. Katznelson documents the changes associated with the domestication of a wild legume, demonstrating how rapidly unintentional selection can result in the dramatic morphological changes associated with domestication. C. Manwell and C. M. Ann Baker utilize protein polymorphism data in an attempt to determine the origins of domestic animals, and present an interesting, if not sufficient, argument for the hybrid origin of domestic cattle and sheep. J. A. Beardmore and S. A. Shami present evidence for an association between parental age and estimates of heritability for meristic characters in fruit flies and guppies and speculate on mechanisms to account for this effect. In the only study of experimental populations in the collection, K. Wöhrmann, R. Strobel, and P. Lange consider the relative distributions of haploid and diploid genotypes in sexual and asexual serial-transfer populations of yeast.

Over the past ten years thousands of kilowatt-hours have been consumed in an effort to estimate the amount and distribution of allelic variation in natural populations, with the meaning of the resulting protein polymorphism data becoming the major subject of controversy in the field. Appropriately, four of the ten papers in the section on models and evidence are concerned with interpreting these data. W. Ewens and M. Feldman present a lucid and critical review of procedures utilizing gene frequency data to test the hypothesis that the variation is a consequence of random genetic drift of selectively neutral alleles. They illustrate the pitfalls of a number of these approaches and question whether it will ever be possible to use a priori distribution theory for a definitive test of the neutral-gene hypothesis. W. G. Hill considers the use of multilocus linkage disequilibria data for a test of the neutral-gene hypothesis, but admits that, at this juncture, his theory is not sufficiently advanced for a definitive test. In his consideration of this problem, B. D. H. Latter groups loci according to the properties of their products and demonstrates a different gene frequency distribution for the different types of enzymes. Although Latter tends to favor a selection hypothesis for this observation, his interpretation is parried by M. Nei, with the ensuing discussion suggesting that the Ewens-Feldman criticism may hold even when one considers gene function. R. K. Koehn and W. F. Eanes present evidence for a high correlation between the heterozygosity of common alleles and the number of rare alleles and offer the rather appealing interpretation that this is a consequence of intracistronic recombination.

Four of the papers in this section deal with specific species. G. Thompson, W. F. Bodmer, and J. Bodmer consider the role of selection, migration, and a variety of other processes in accounting for the high levels of heterozygosity and for linkage disequilibrium at the two major loci of the human lymphocyte-antigen system. P. O'Donald considers the fit of some models of sexual selection to observations made in natural populations of the arctic skua and presents a mechanism whereby the opposing forces of sexual and natural selection could account for sustained polymorphisms. F. B. Christiansen and O. Frydenberg presents an exhaustive statistical analysis of the components of natural selection in eelpouts. W. Seyffert and G. Forkmann explore a model to account for the concentrations of anthocyanin in defined genotypes of *Matthiola incana*.

J. Sved presents models for heterotic selection at multiple loci and discusses the biological basis for this kind of selection. He also points out the difficulties in attempting to distinguish between the models empirically. In the final paper in this section, B. Wallace utilizes an approach that differs markedly from those traditionally employed in population genetics. He presents a model derived from developmental considerations, a specific elaboration of that of Britton and Davidson for hierarchal control of gene action, and considers how this single model can account for an array of apparently unrelated population genetic phenomena. The model has the virtue and, as Wallace admits, the liability of explaining too much. Whether it is to prove realistic remains to be seen, but it seems certain that population geneticists will soon have to deal with these kinds of developmental considerations.

Until recently most formal-mathematical treatments of selection assumed populations to be unique, dimensionless points in space. In four of the theoretical studies in this collection consideration is given to the process of selection in geographically structured populations. S. Karlin presents an array of models of selection in multideme populations and gives particular emphasis to the conditions under which the combined actions of selection and migration will allow for the maintenance of polymorphisms. In collaboration with N. Richter-Dyn, Karlin considers the kinds of gene frequency clines obtained from different migration and selection schemes in linear arrays of demes. The articles by M. Slatkin and by K. P. Hadeler consider the spread of selectively advantageous alleles in deme-structured and in continuous populations respectively.

The contribution by M. W. Feldman and J. Krakauer includes both new results on the evolution of neutral alleles that modify the action of loci under selection and extensive review of the kinds of situations for which population geneticists have invoked the action of "modifier genes" and the mechanisms that have been postulated to account for their evolution. In an attempt to formally bridge the gap between micro- and macroevolutionary theory, M. Nei presents mathematical models for the evolution of reproductive isolation and considers the time required for the isolation process. He al-

so considers the related problems of gene differentiation among subpopulations and between pairs of subpopulations and presents estimates of genetic distance for different taxonomic relationships. D. L. Hartl and R. D. Cook expand on their earlier work on models in which fitness values vary randomly with time and consider the role of this form of temporal heterogenity on the maintenance of polymorphisms. In an effort to study the phenomenon of genome "crystallization," the spreading of regions of linkage disequilibria observed in multilocus simulation studies, C. Strobeck analyzes models of multiplicative selection in a three-locus model. In a relatively brief paper, C. C. Cockerham adds generality to an earlier theoretical conclusion that the number of heterozygotes left by a neutral gene progressing toward fixation is independent of the structure of the finite population in which the gene occurs.

The paper by C. Matessi and S. D. Jayakar is an attempt to weld population genetic theory with population ecology theory. The authors utilize the classical Lotka-Volterra model of interspecific competition in a study of density- and frequency-dependent selection among genotypes of a single species and interpret their results in terms of the concept of niche expansion. I Eschel and D. Cohen present a mathematical model that both formalizes and expands on the concept of inclusive fitness and consider how the model can account for the genetic evolution of such socially positive and intuitively unlikely phenomena as altruism among unrelated individuals. Unfortunately, as is the case with much of this theory, the analysis is presented in terms of fitness gains and losses and coefficients of relatedness rather than in the—to a geneticist—more tangible terms of changes in allele frequency.

Owing, presumably, to the editing, the discussion section of the book reads somewhat like an array of isolated pronouncements and lacks give-and-take. The section is worth reading carefully, however. Much of the discussion revolves around the nature and role of theory and strategies of model construction. What is the value of a general theory that is not amenable to testing in specific cases? Of what general use are models developed for very specific situations? Should mathematical models be used only as an aid to intuition in the development of theory, or should one be able to estimate their parameters in specific systems and explore the validity of the resulting theory by comparing predicted and observed behaviors? Of what value is an equilibrium theory in a generally nonequilibrium world? Also, in this discussion, a number of the participants offer their views of what the significant unsolved problems in population genetics are and how they should be attacked. Although I question many of their priorities and believe there are a number of significant problems they have not considered, I agree with the general message. Wright, Fisher, and Haldane did not solve all the really big problems in evolutionary genetic theory. The empirical problems of this field will require more than just a source of direct current for their resolution.

In summary: As measured by the density of good, up-to-date articles dealing with fundamental problems, this is a very important collection. It is, however, a collection for professional population biologists. I do not believe that the number of pedagogically useful papers is sufficient to warrant its purchase by any but the most advanced students.

BRUCE R. LEVIN
Department of Zoology,
University of Massachusetts, Amherst

A Great Fluvial System

The Nile. Biology of an Ancient River. JULIAN RZÓSKA, Ed. Junk, The Hague, 1976. xx, 418 pp., illus. Dfl. 120. Monographiae Biologicae, vol. 29.

The modest title of this book belies the magnitude of its task. For the Nile is more than just a river. It is an immense system that means the difference between life and death for a substantial portion of Africa. The editor's characterization of it as a "life artery" evokes a proper image to convey its importance.

This great river has two major tributaries. The Blue Nile originates in Lake Tana in the high mountain ranges of Ethiopia and surges through the chasms of the Great Abbai Gorge, steadily gathering the tremendous sediment load known as the "gift of the Nile," which supports agriculture in the delta more than 600 kilometers to the north. (In the late 1790's Napoleon's engineers calculated that this accumulation averaged 0.1 centimeter a year, and recent determinations have shown this figure to be accurate within 10 percent.) The White Nile arises near the equator in the vicinity of the Great Lakes George, Albert, Victoria, and Kioga. These natural reservoirs serve to stabilize the water flow, so that the White Nile provides a continuous if somewhat fluctuating contribution throughout the year. The White Nile travels more than twice the distance of its sister tributary before reaching the Mediterranean. On its way north it passes through the Sudd, whose name in Arabic means "blackage," a vast and formerly impenetrable region of floating papyrus mats and associated aquatic vegetation. This was the great disease-ridden swamp that was the main and often lethal obstacle in the way of the 19th-century European explorers seeking that elusive goal that captivated the imagination of Victorian England, the source of the Nile. The two great water sources unite at Khartoum and continue northward, joined by other tributaries and passing at last through the great northern deserts whose expansion, especially during the last 3000 years, has truly separated Egypt from the rest of Africa. This, then, is the environment this book deals with: no single river, but a series of lakes, rapids, swamps, falls, tributaries, and river sections that cover thousands of miles and together contribute in time and space to what we call the Nile.

The book itself covers the biological aspects of all these features in encyclopedic fashion. The many contributions range from archeology to zoogeography, from a treatment of the characteristics of the river's water to a fascinating account of the cultivars and domesticated animals of ancient Egypt. Not every possible topic is considered, but it appears that all areas for which there is a reasonable amount of information available are covered. For readers seeking more detail, there are bibliographies at the end of each of the 27 chapters or groups of chapters. The editor has woven these varied styles and contributions together into a whole that is both cohesive and interesting.

Within the last decade considerable changes in this ancient system have been effected by man, primarily through the building of dams, and also through the introduction of new species. Since the book draws heavily on data from the period before these changes occurred, it may well be invaluable as a baseline study for future generations of scientists assessing their long-term effects. In his section on the fish fauna of the Nile, P. H. Greenwood comments that owing to man's recent interferences the next hundred years could well see changes as profound as those that have taken place over the last million on this venerable river. It will be interesting to read an updated edition of this volume 25 years hence.

THOMAS M. ZARET
Department of Zoology,
University of Washington, Seattle