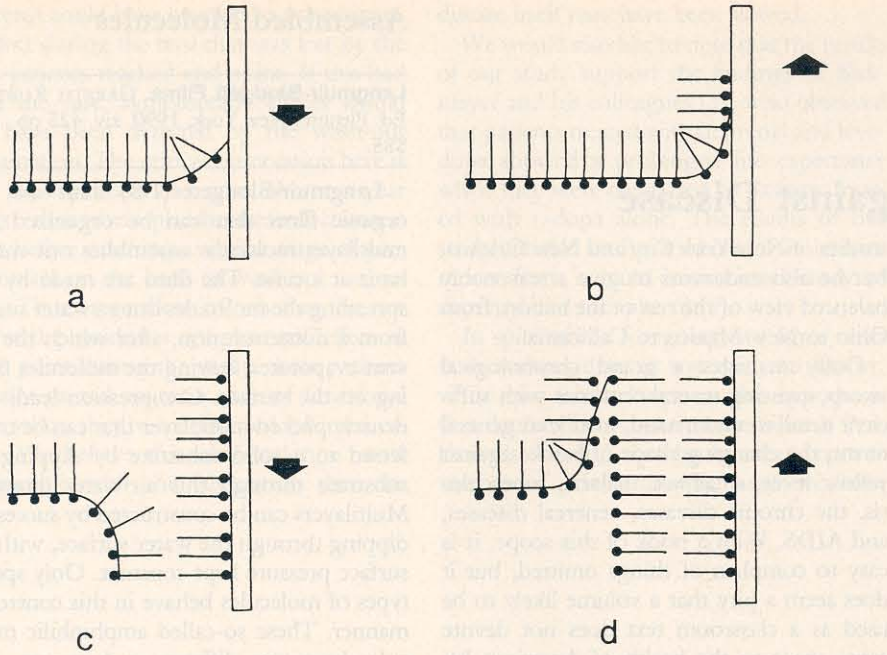

"Deposition of multilayers by the Langmuir-Blodgett technique: (a) first immersion, (b) first withdrawal, (c) second immersion, (d) second withdrawal." [From *Langmuir-Blodgett Films*]

insight into the early development of LB films. Next, starting with the fatty acids and their salts, the reader is introduced to many of the new compounds containing, for example, unsaturated groups, aromatic groups, chromophores, or polymers. The Langmuir-Blodgett assembly process, much of which is more art and recipes than science, is covered in detail—many of the "tricks of the trade" known to the experts and baffling to the novice are described. Techniques for characterization of the films are presented, compared, and evaluated. Almost all of the important optical and electrical methods, together with current results, are described in sufficient detail to give the reader a good idea as to their applicability and significance.

In contrast to the book's very good beginning, the treatment of the last three subjects dealt with is slightly less satisfying. The discussion of spectroscopy is based largely on older work from the author's institution, with only brief mention of newer studies. Although interesting, the study of biomolecular assemblies is clearly not as advanced as other LB work, simply because the molecules are more complicated and the experiments more difficult. Finally, proposed applications for LB films are discussed including electron beam lithography, pyroelectric infrared detectors, nonlinear optical effects, sensors, and modifications to semiconductor devices. Though these seem feasible, we all wait for the realization of the first significant application, possibly in biosensing, to spur the field on even more. It is to be hoped that this last chapter will stimulate new ideas for further scientific and technological applications.

In spite of a few minor flaws, *Langmuir-Blodgett Films* is well worth reading both for experts, for whom it forms a handy reference, and for those desiring to learn something about LB films. The authors have covered the subject thoroughly, as indicated by the numerous references. The book can be read from almost any point without too much dependence on facts and details presented earlier in the text. It also should make clear to those in the field where more research is needed and should become as important a key to future development of the field as Gaines's book was many years ago.

JEROME D. SWALEN
IBM Almaden Research Center, San Jose, CA 95120

Birds under Selection

Evolutionary Dynamics of a Natural Population. The Large Cactus Finch of the Galapagos. B. ROSEMARY GRANT and PETER R. GRANT. University of Chicago Press, Chicago, 1990. xx, 350 pp., illus. $65; paper, $24.95.

Genetic variation is the raw material of evolution, and elucidating how variation is generated and maintained is a principal aim of evolutionary biology. In this excellent monograph, Rosemary and Peter Grant recount the results of an intensive investigation of the factors influencing morphological variation in a population of the large cactus finch (one of Darwin's finches) on the small, isolated island of Genovesa. This population exhibits an unusual amount of variation in beak dimensions, compared with continental finches. Such variation is of particular interest because the evolution of beak characters is a prominent feature of the adaptive radiation of Darwin's finches. A central message in their story is the importance of environmental variation in evolutionary dynamics. The fieldwork, begun in 1973 and completed in 1988, spanned several finch generations and natural climatic perturbations, including severe droughts and years of high rainfall. Given that experimental manipulations of this population were immoral, illegal, and even impractical, the detailed profile of the population provided by a long time series proved essential for addressing fundamental questions about the nature and consequences of variation.

Badly stated, the authors' essential conclusions are as follows. Species are not static but dynamic entities, capable of dramatic change. A highly variable, unpredictable rainfall regime causes marked fluctuations in the availabilities of finch foodstuffs. This in turn drives substantial annual variation in survivorship, reproduction, and population structure, produces a high variance in reproductive success, and leads to a shifting regime of directional selection on beak morphology. In many years selection appears to be weak or absent, but in others it is strong. Following an El Niño event in 1983, *Opuntia* flowers and fruit became scarce and birds adept at utilizing these resources, because of their relatively long bills, were initially disfavored. But later in the drought, selection acted in the opposite direction; birds with larger bills are better able to tear open dried-out *Opuntia* pads. Parent-offspring regressions showed that beak characters are highly heritable, providing substantial potential for rapid evolution in response to selection. Small sample sizes precluded a direct assessment of this possibility; a perennial frustration of field studies is that sample sizes are often too low to provide strong tests of hypotheses. Grant and Grant use an indirect method to argue that the consecutive, opposing selective episodes canceled each other out. Although the population is never quite in demographic or evolutionary equilibrium (indeed, one has the sense that even an 11-year time slice may not adequately characterize the dynamic character of this species), the authors conclude that it fluctuates around an optimal phenotype, a peak in an adaptive landscape determined by the availability of different food types and the presence of competing finch species. These conclusions recapitulate, in a study tightly focused on a single species, a number of the themes developed by Peter Grant in his earlier, more

general, treatise on Darwin's finches (*Ecology and Evolution of Darwin's Finches*, Princeton University Press, 1986).

In the course of developing their central thesis, Grant and Grant make illuminating observations on a number of important issues in evolutionary ecology, ranging from life-history evolution to mate choice. For this reader, the most intriguing is their conclusion that introgression among related species can be a significant source of intraspecific variation. The estimated effective population size is too low for mutational input to account easily for the observed level of genetic variation. The authors argue that the depletion of genetic variation by selection is balanced by the introduction of variation through a low level of hybridization with other finch species. An important direction for future work complementing the sorts of demographic and morphometric studies of variation reported in this book will be more direct assessment of introgression by means of molecular markers.

The hypothesis that a significant fraction of intraspecific genetic variation has an interspecific origin provides a fresh perspective on the relation between community ecology and evolutionary biology. Traditionally, the community is viewed as merely setting the selective stage for microevolution. But with occasional hybridization, species that are competitors over ecological time may be mutualists over evolutionary time, each providing a store of genetic variation that can be tapped by the other. The tidy nodes of phylogenetic trees become blurred with hybridization. Maybe we should all be grateful that Mother Nature is a bit slovenly when it comes to reproduction, for this may ultimately permit the unfolding of the bountiful diversity of life on earth.

ROBERT HOLT
Museum of Natural History, University of Kansas, Lawrence, KS 66045-2454