GROUP SELECTION AND EVOLUTION

The Natural Selection of Populations and Communities, by David Sloan Wilson. Benjamin/Cummings Publishing Company, Menlo Park, CA, 1980, 186 p., illus., $12.95 (79-19139).

Group selection undoubtedly influences evolution, but its true significance is still unknown. Mathematical models of group selection have usually shown that the crucial parameters of extinction and colonization rates must be at extreme and rather unlikely values for group selection to overpower individual selection. David Sloan Wilson now argues in a stimulating monograph that a quite different group selection mechanism routinely favors a heretofore neglected class of altruistic traits, by him christened "weakly altruistic." A weakly altruistic trait confers a positive fitness increment upon its bearer, but an even larger benefit upon other individuals. If natural selection favors alleles with high relative fitnesses, weakly altruistic traits should seemingly never evolve. Wilson demonstrates that weakly altruistic traits can be selected for if populations possess an internal structure such that interindividual effects are heterogeneously expressed.

The deme, the unit of traditional group selection models, is reproductively self-contained, whereas the unit of Wilson's models is the "trait group"—a subdivision of a deme within which the ecological effects of a trait are expressed and between which interactions are negligible. Thus, a deme is a metapopulation of trait groups, and natural selection is a compound of gene frequency changes *within* trait groups and differential productivity *among* trait groups. Wilson pays particular attention to selection in demes with trait groups generated by a random, binomial sampling process. In his basic haploid, discrete-generation selection model, an allele (A) confers a benefit (d) upon itself and a benefit (r) upon all other members of its trait group. If the trait group comprises the entire deme, (A) increases in frequency only if (d) is greater than (r). If trait groups arise from a binomial sampling process, the condition for increase is that (d) be greater than zero, irrespective of (r). Given a trait-group variance in allele frequency greater than the binomial, alleles with (d) less than zero increase for sufficiently great (r). Throughout the book, Wilson's basic strategy is to consider selection for traits that directly or indirectly increase population productivity. The individual bearing allele (A) gains a benefit—its ration of the increase in total population productivity—but incurs a cost not experienced by other population members. He explores several mechanisms for maximizing population productivity, and suggests that the sensitivity of selection to indirect effects provided by structured demes suffices to mold communities into superorganismal assemblages of mutually beneficent species.

This book has many merits and deserves careful reading. It is refreshing to see heterodox ideas (e.g., the efficacy of group selection, the community as a Clementsian superorganism) stoutly defended within the context of contemporary ecological models. It is clearly written and is full of intriguing examples that beg for fuller empirical and theoretical treatments. However, I believe that Wilson has seriously misconstrued the nature of selection in populations with a binomial trait-group structure. His attempt to force his model into a group-selection straitjacket is certain to distract attention from his many interesting ideas.

Wilson's error is one not of algebra but of interpretation. As he himself notes (p. 45), group selection should be defined as "the component of natural selection that operates on the differential productivity of local populations within a global population." Yet he nowhere demonstrates that differential productivity actually accounts for selection in structured populations. It is true that in unstructured populations an increase in population productivity actively inhibits selection. But binomial trait-group variation does not transform productivity from an inhibitory factor into an actively beneficial agent for selection. Instead, this population structure makes population productivity *per se* irrelevant to selection, as the effect of a newly arisen, weakly altruistic allele upon the fitness of its non-altruistic, trait-group neighbors will be diluted by the large number of unaffected, non-altruistic alleles present in the entire population. Moreover, of two alleles with equal self-effects but unequal effects on population productivity, the one with the smaller effect on local productivity will increase at a faster rate. With a larger than binomial trait-group variance, the allele with greater effect can be directly selected; *this* is group selection via differential population productivity. But in populations with a binomially distributed trait-group strcuture—the primary population structure considered by Wilson—we see not the routine action of group selection but the solipsism of individual selection, for which an apt maxim might be, "To thine *own* fitness, accrue."

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ASSESSING EFFECTS OF AIR POLLUTION

Assessing Toxic Effects of Environmental Pollutants, edited by S. D. Lee and J. Brian Mudd. Ann Arbor Science Publishers, Ann Arbor, MI, 1979, 306 p., illus., $30.00 (78-71430).

Assessing Toxic Effects of Environmental Pollutants hardly represents a noteworthy thesis on this broad subject. Indeed, it is no more than a collection of 15 papers presented at a symposium of the American Chemical Society, the majority of which come from the authors' parent organizations. The title is misleading because virtually all papers are directed toward air pollutants with no specific papers on water or terrestrial pollution.

Having overcome the initial shock and disappointment of a misleading and narrow scope, coupled with poor organization (as evident from a quick review), one can nevertheless glean some redeeming value from the papers. Taken individually, most chapters present useful information, albeit far from a thorough review of the subject areas. Had one chapter been prepared that would tie the whole science of hazard and risk assessment together, especially as it relates to pollutants, then one could recommend the book as a valuable reference on its stated title. Unfortunately this cannot be done.

The opening chapter on extrapolation from animals to man had the potential to tie together the animal and epidemiological aspects reasonably well-presented in other chapters. However, this important chapter falls far short and does not provide the reader with many useful ideas on extrapolation and risk assessment. Outside of discussions on the Ames test and vitamin E, it presents a pedestrian synopsis of extrapolation problems. This does not compare favorably with the authors' previous literary contributions.

All is not lost, however, as several chapters present useful data and information on state-of-the-art procedures. The contribution by Stara and Kello, "Relationship of Long-Term Animal Studies to Human Disease," is the most useful chapter, presenting a good synopsis of the experimental design aspects of chronic animal experiments. Other good reviews on applied toxicology are those of Mustofa and Lee—"Biological Effects of Environmental Pollutants"—and that of Frederick Miller—"Biological Modeling Applications in the Evaluation of Ozone Toxicity." Both present searching reviews worthy of praise. In addition, the chapter of Bhatnagar et al. on lung organ culture systems is a work of art, lucidly explaining their potential role in research and testing of environmental chemicals.

I cannot recommend this book to those wanting a thorough review of assessment methods. Had a good summary chapter been prepared, and were the work better organized, there would have been more reason for praise. Nevertheless, the individual contributions, for the most part, may warrant consideration.

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