Evolutionary Biology

VOLUME 32

Limits to Knowledge
in Evolutionary Genetics

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Preface

This collection of chapters is the result of a project funded by the Alfred P. Sloan Foundation on the "limits to knowledge." The Sloan Foundation has funded several projects to explore limits to knowledge in various areas of science, and I was privileged to acquire funding from the foundation to explore limits to knowledge in evolutionary biology. My particular approach to this interesting question was to organize a small meeting with a number of prominent evolutionary geneticists and philosophers of science, held in January 1998, in Riverside, California. The participants were asked to bring an essay on the question of limits to knowledge to the meeting, and this volume is the revised and edited fruit of that endeavor.

Why consider the notion of limits to knowledge? Some of the participants in the Riverside meeting, and many others, have questioned the value of even asking whether there are limits to knowledge in evolutionary biology. Some are concerned that considering the question of limits somehow might give ammunition to the creationist movement and thereby weaken public and scientific support for the science of evolution. This is certainly a justifiable concern when political and religious doctrines are sometimes cloaked as science and presented to educators for inclusion in science curricula under a disingenuous equal-time argument. I believe the answer to this objection is eloquently addressed in the essay by the philosopher and historian of biology, Michael Ruse (Chapter 1), who makes a crucial distinction between the scientific fact of evolution and the scientific problem of reconstructing its paths and causes. There is no dispute about the fact of evolution among the authors of these chapters, or indeed among the vast majority of scientists engaged in understanding the history of the earth and of the life forms that occupy it.

Even granting that a study of limits does no damage, is there value in addressing this topic? I believe there are two positive answers to this question. The first is that a search for limits should help illuminate the fruitful questions taken from those biologically interesting questions that are presently (or perhaps permanently) outside the reach of science. The nature of science is to work on the boundaries between the known and the

unknown. These boundaries shift as new methods are developed (e.g., the invention of the microscope, or more recently the elaboration of rapid DNA sequencing technologies) and as new concepts are elaborated (e.g., the theory of the gene, or more recently, the coalescence framework in population genetics). These new tools allow us to address a set of interesting questions that previously were outside the realm of science; as a consequence, the boundary between the knowable and the unknowable has shifted. I contend that a study of limits should reveal and clarify the boundaries and thereby make sharper the set of fruitful questions.

My second reason concerns the place of science in major public policy debates. We are presently witnessing a major debate about global warming, where the methods of science and the limits of science are sometimes misunderstood by public policymakers. I was stimulated to consider the limits to knowledge in the applied science of conservation biology as Chair of the National Research Council Committee on Science and the Endangered Species Act. The theoretical foundations of ecology and population genetics play a major role in the science of biological conservation. For instance, theory, in conjunction with empirical information, informs approaches to reserve design and to the elaboration of breeding strategies. The fundamental science of evolutionary biology is called on by managers in deciding when a species is no longer in danger of extinction and when a listing is the appropriate action. The list of places where scientific information is applied in this field could be extended indefinitely. So we can conclude that knowledge in evolutionary biology is used in manifold ways to solve practical problems. What is intriguing and often underappreciated is that our knowledge base is often approximate, conditional, and subject to revision as the dialogue of science advances. Policymakers and the society they serve expect science to provide answers to problems that may transcend the boundaries of scientific knowledge. A frank exploration of these boundaries seems highly appropriate.

Let me now address the title of this volume. In the course of this project, I came to realize that evolutionary biology is too large and too diverse a topic for the set of chapters that are presented here. I am a population geneticist who also works in molecular evolution. The authors of the chapters presented in this volume reflect my particular interests, and it is clear that the center of gravity is heavily weighted toward population and quantitative genetics. Accordingly, the volume is given the more restricted title "Limits to Knowledge in Evolutionary Genetics."

I want to thank the Alfred P. Sloan Foundation and Dr. Jesse Ausubel for their support of this project. I thank my colleagues, Dr. Michael Cummings and Dr. Mary Durbin, for their ideas and contributions to this effort. I also thank Ms. Cindi McKernan for assistance with the Riverside meeting,

Ms. Laura Heraty for help with the final preparation of the manuscripts, and the Department of Botany and Plant Sciences at the University of California, Riverside, for providing unstinting assistance. Finally, I am deeply indebted to the participants who enthusiastically explored and critiqued the idea of limits and who patiently wrote and revised their chapters for this volume.

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