to vary parameters systematically and obtain independent replicates within a reasonable time frame.

Some users may feel a bit constrained by what cannot be done with avida. The software precludes sexual recombination of programs, and does not allow rewards to vary in space (which would provide opportunities for the evolution of stable communities composed of many programs, each filling a distinct niche). Of course, avida itself may evolve as features are added to subsequent versions. Updates and related information can be obtained from a web page (http://www.krl.caltech.edu/avida). Other users may object to the simplicity of tasks that are rewarded, limitations in the instruction set, and so forth. Still others may reasonably ask whether results can be extended to real organisms. In extrapolating from the genetics of bacteria to animals, Jacques Monod is said to have quipped that "What is true for *E. coli* is also true for elephants, only more so." Is what is true for avidians also true for real organisms, or is it less so? It will be interesting to see.

EVOLUTION

# Knowledge from the Flies

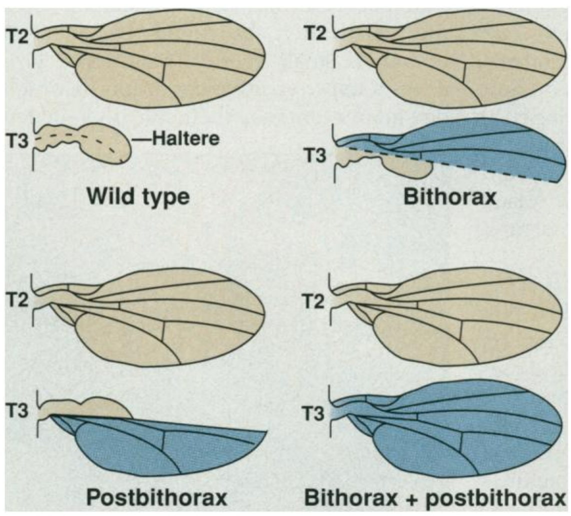
Walter F. Eanes

**Progress and Prospects in Evolutionary Biology: The *Drosophila* Model.** JEFFREY R. POWELL. Oxford University Press, New York, 1997. xiv, 562 pp., illus. $70. ISBN 0-19-507-691-5.

As one of several so-called biological models, the fruit fly genus *Drosophila* has contributed to more fields than any other group. Nowhere is this more evident than in evolutionary biology, where many contemporary principles and hypotheses have their origin in *Drosophila* studies dating back to the 1920s. In no other group of organisms can evolutionary questions be attacked with such precision and sophistication. For these reasons, *Drosophila* population geneticists are a particularly self-critical lot.They tend to emphasize how much we do not know, and to forget just how much we have discovered. Jeffrey Powell's book, *Progress and Prospects in Evolutionary Biology: The* Drosophila *Model*, corrects these oversights. It is a succinct review of the contributions these wonderful organisms have made to many themes in evolutionary biology.

Powell's mentor Theodosius Dobzhansky, along with Chetverikov, Morgan, Sturtevant, and Muller, introduced *Drosophila* into the study of evolution over seven decades ago. The sheer volume of references that have appeared in the last decade alone make it clear that evolutionary studies in *Drosophila* continue to expand, furthered by the gains *Drosophila* enjoys as a model in other fields including molecular biology, developmental biology, neurobiology, and behavior.

Powell devotes the initial chapters to a historical and philosophical overview of genetic variation in natural populations, the topic to which *Drosophila* has contributed the most in evolutionary biology. He discusses the levels of variation that have been traditionally examined: visible mutations, lethals, allozymes and polygenic variation. Subsequent chapters detail such topics as chromosomal inversions, speciation, ecological genetics, phylogenetics, genome evolution, molecular evolution, and development. Although this is a book on evolution, the chapter on ecology is a useful addition. It emphasizes just how much more ecological work is needed to better understand evolution in this genus. The informative chapter on speciation outlines the complex data from and arguments surrounding the large body of genetic work that has emerged quite recently, and it is nice to have all of this in one place. Powell acknowledges that the chapter on development, mainly a review of the contribution of *Drosophila* to studies of development, was the most difficult to write. Despite the enormous contribution *Drosophila* has made to developmental biology, extending these discoveries into an evolutionary context within the genus has so far proved rather unsatisfactory.




**Two sets of wings.** In wild-type *Drosophila*, the second (T2) and third (T3) thoracic segments in adults have a wing and a haltere. Flies with two mutations (in the *bithorax* and *postbithorax* genes) have four wings, the evolutionarily primitive state in flying insects.

The final chapter returns to issues raised in the introduction and summarizes just how far we have come and where efforts should now be directed. Most of the quest to characterize genetic variation in population genetics has been technology driven. Powell is right in stating that, with the development of large-scale DNA sequencing methods, the goal of characterizing genetic variation has been taken to the limit. As he says, the discipline must now turn away from simply describing pattern, direct its efforts toward understanding processes, and once again become experimentally oriented. Furthermore, efforts to understand the historical impact of natural selection can only be considered in the context of changing population size, as in models now emerging in population genetics.

Although evolutionary studies have focused on a large number of *Drosophila* species, I am pleased to see everyone's favorite lab organism, *Drosophila melanogaster*, finally getting top billing. According to folklore, Dobzhansky maligned this species as a "garbage can species," and 25 years ago only a handful of population geneticists focused on it. Nevertheless, the new understanding of its ancestral structure in Africa and the discovery of endemic island relatives have moved this species to the forefront of many studies of the genetics of speciation. This is very important because the explosive development of this species as a model in cell and developmental biology significantly facilitates understanding the genes that generate the differences between species.

Powell emphasizes his own favorite issues, subjects of his reviews in recent years, and occasionally takes the opportunity to rebut studies that conflict with his own work. This is the author's license. The impact of Dobzhansky's work in his former

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student's review is also evident. For example, an entire chapter is devoted to population cage experiments. Perhaps this should be included for completeness, but many contemporary *Drosophila* population geneticists question whether theses studies tell us much about selection in natural populations. There are occasional interpretations and assertions that would, not unexpectedly, be debatable among colleagues, but for the most part Powell resists presenting dogma or self-serving paradigms. This is not a controversial work, nor was it meant to be.

Powell states that his efforts are directed toward first-year graduate students seeking a research problem; toward *Drosophila* workers who are not evolutionary biologists, but who seek an evolutionary perspective; and toward evolutionary biologists who do not study *Drosophila*, but who need to familiarize themselves with the many contributions of *Drosophila* research. His book should be successful on all these counts. This book is a most useful resource, and I expect our lab copy to become well worn by graduate students and colleagues.

## Browsings

**Animal Groups in Three Dimensions.** Julia K. Parrish and William M. Hamner, Eds. Cambridge University Press, Cambridge, 1997. 395 pp., illus. $90. ISBN 0-521-46204-7.

Schools of fish, flocks of birds, and swarms of insects are cohesive wholes that seem to transcend the properties of their individual members. The authors in this volume present a variety of perspectives on studying such groups, including data collection, analytical methods, behavioral ecology and evolution, and mathematical modeling.

**Licensed to Kill?** The Nuclear Regulatory Commission and the Shoreham Power Plant. Joan Aron. University of Pittsburgh Press, Pittsburgh, PA, 1997. 200 pp., illus. $45. ISBN 0-8229-4044-2. Paper, $18.95. ISBN 0-8229-5649-7.

Recounted here is the saga of the decisions to build and then abandon a $5.5-billion power plant, and the breakdowns of government policy-making and public trust. Aron explores the implications for future decisions about technology that present large-scale risk, and offers suggestions for avoiding similar fiascoes.

**Mobile Multimedia Communications.** David J. Goodman and Dipankar Raychaudhuri, Eds. Plenum, New York, 1997. 324 pp., illus. $95. ISBN 0-306-45772-5.

This collection of 36 technical papers is from a 1996 workshop on delivering advanced information technology to a mobile population. The research on networks, protocols, media access, and signal processing will be important in creating the technology required to merge Internet and mobile communications services.

**Northwest Atlantic Groundfish: Perspectives on a Fishery Collapse.** John Boreman, Brian S. Nakashima, James A. Wilson, and Robert L. Kendall, Eds. American Fisheries Society, Bethesda, MD, 1997. 264 pp., illus. Paper, $39. ISBN 1-888569-06-9.

This analysis discusses how and why the resources declined (citing persistent recruitment overfishing as the major reason), and various management considerations that might lead to their recovery.

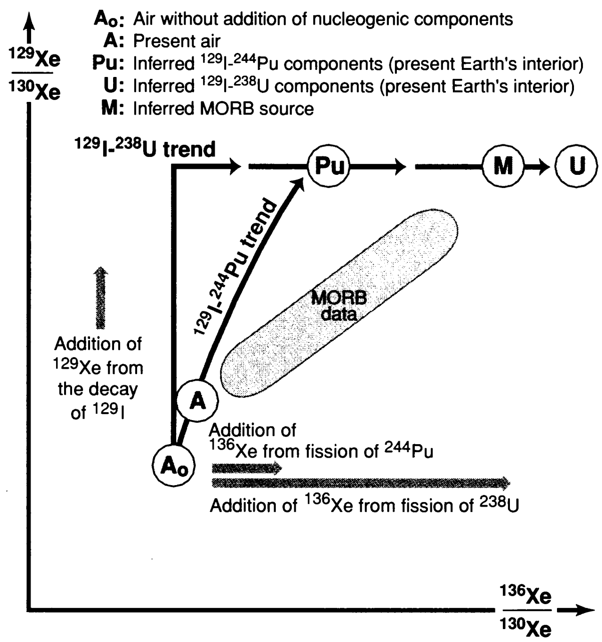
RESEARCH: GEOCHEMISTRY

# Xenon's Inside Story

Ichiro Kaneoka

Terrestrial xenon isotopes are especially important in the effort to understand Earth's evolution, mainly because they include decay products of extinct nuclides such as $^{129}I$ and $^{244}Pu$ that were present during the formation of the early solar system. Moreover, isotopic compositions of the atmosphere are different from those inferred from extraterrestrial materials, so understanding the interplay between mantle and atmospheric reservoirs is important. This is because the atmosphere, with its substantial amounts of these isotopes, is thought to have been formed by degassing from Earth's interior. Hence, its characteristics should reflect the properties of the original material from which Earth was formed. As reported on page 877 of this issue, Kunz *et al.* (*1*) have used precision mass spectrometry on mid-ocean ridge basalts (MORBs) to resolve a number of questions about the xenon budget of Earth.

This budget is complex. The decay product of $^{129}I$ is $^{129}Xe$, and $^{244}Pu$ undergoes fission to produce excesses in $^{131\text{-}136}Xe$, whereas $^{130}Xe$ is protected from secondary addition of any possible reaction products. Thus, isotopic ratios such as $^{129}Xe/^{130}Xe$, $^{136}Xe/^{130}Xe$, and so on reflect the evolutionary history of material that retains Xe, giving constraints on the early history of Earth (*2*). It has been revealed that some terrestrial samples such as MORBs, $CO_2$ well gas, and diamonds show excesses in $^{129}Xe$ and $^{131\text{-}136}Xe$ compared with atmospheric xenon (*3*, *4*). On the basis of such observations, the past occurrence of $^{129}I$ in Earth's interior has been widely accepted. However, the occurrence of $^{244}Pu$ is controversial because fission-produced components from $^{238}U$ can also give excesses in $^{131\text{-}136}Xe$ isotopes and the patterns of fissiogenic xenon between $^{244}Pu$ and $^{238}U$ are rather similar with small dif-




**Interior trends.** Schematic plot indicating the variation in the $^{129}Xe/^{130}Xe$ and $^{136}Xe/^{130}Xe$ ratios. Variations in the $^{129}Xe/^{130}Xe$ and $^{136}Xe/^{130}Xe$ ratios are controlled by $^{129}I/^{130}Xe$ and $(^{244}Pu + ^{238}U)/^{130}Xe$, respectively, including the time of degassing. The solid arrow line in red indicates an evolution trend for the $^{129}I\text{-}^{244}Pu$ system, whereas the solid arrow line in green indicates an evolution trend for the $^{129}I\text{-}^{238}U$ system. The inferred MORB source value based on Kunz *et al.*'s data (*1*) suggests a mixing between the two systems. The shaded MORB area indicates the data obtained by them.

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