Anachronistic Relationships

The Ghosts of Evolution: Nonsensical Fruit, Missing Partners, and Other Ecological Anachronisms. Connie Barlow. Basic Books, New York, 2000. 291 pp., illus. $26.00 (ISBN 0-465-00551-9 cloth).

In Costa Rica, fruit lies in heaps on the forest floor, left to rot. In New York City, ancient ginkgo trees invest tremendous energy in producing a great abundance of fruit that, again, goes largely uneaten. The questions are, then, For whom is the fruit produced? Where are the dinner guests? Why the waste? In *The Ghosts of Evolution: Nonsensical Fruit, Missing Partners, and Other Ecological Anachronisms*, Connie Barlow brings both experimentation and highly informed speculation to bear on the mystery. The evolution of fruits enhances seed dispersal for plants. Often, the plant and its animal disperser coevolve in a tight mutualistic relationship: In some cases, fruits are edible for only one species and contain toxins that kill others; and some seeds will germinate only after passing through the intestine of their specific disperser.

The Ghosts of Evolution is concerned with what happens when a plant's main dispersal agent becomes extinct. In the sense that the plant is still producing fruit for a long-gone disperser, the fruiting is anachronistic, and the extinct animal that aided the evolution of the still-bountiful fruit is a ghost species.

Bringing the work of ecologists Daniel Janzen and Paul Martin to a wider readership, Barlow is a science popularizer. But she is so thoroughly immersed in the material that the line between scientist and science writer is blurred. This is a good thing. Barlow infects us with her scientific enthusiasm at first hand. One of the sweeter rewards of scientific learning is the way it brings new perceptions. After reading this book, a visit to the grocery store is a different experience. Anachronistic fruits abound: paw paw, squash, persimmons. As I pick over the avocados, I look over my shoulder for ghost megafauna—gomphotheres and giant ground sloths. I am a very poor sort of disperser: I will throw the seed in the trash. But the avocado's seed probably evolved to travel through the gut of a ground sloth, to be expelled from its rear end, and to germinate in fresh dung.

Or did it? Scientists who make informed guesses about nonexistent creatures or apparently adaptive traits risk "dragging an entire discipline into the mire of untestable assertions" (p. 80), as Barlow quotes ecologist Henry Howe. Ecology is the discipline to which Howe refers, but this book addresses questions at the intersection of another discipline—paleontology. So we have paleoecology at the juncture of a historical science and ecology, whose variables are so many and complex that simple findings are hard to come by. Barlow, although convinced that the anachronism idea is valid, treads very carefully through the mire. She avoids oversimplification by proposing a classification system whereby species can be extremely, substantially, or moderately anachronistic. In other words, a continuum exists, from plants whose fruits are ignored by all extant animals to species that enjoy the attention of modern dispersers but are "overbuilt" or overabundant in a way that suggests an absent disperser.

And Barlow is constantly aware of overreaching, that is, of enveloping too many species within the anachronistic fruit hypothesis. Indeed, *The Ghosts of Evolution* gives speculation a good name. A valuable hypothesis has at least four important qualities: It is testable, it makes predictions, it has explanatory power, and it suggests other hypotheses. Of course, the missing partners in plant–disperser relationships cannot be observed without a time machine. But some things can be known without observation. For example, we can assume that extinct dinosaurs had red blood. Can we also assume that a specific tree is producing fruit for a particular species that just happens to be absent? Janzen, Martin, and Barlow might be wrong in the particulars, but they present so much evidence suggesting they are right in general that I find myself convinced of the broad principle.

Am I a soft touch? Well, Darwin's theory was, for many years, untestable, but its explanatory power was so broad that it enjoyed almost universal acceptance. Thus science may move forward without experimentation when the evidence, even if circumstantial, is overwhelming. Such is the case for the anachronistic fruit hypothesis. As Barlow says, "When ascertaining the evolutionary ecology of an organism, do we limit our reach to the present, no matter how impoverished the present may be? Or do we welcome ideas that include the whole cast of characters that accompanied a lineage...in its evolutionary journey?" (p. 79).

The richness of this evidence is the great reward of this book: We learn of the relationships between the elephant and balanite seeds and the tambalacoque tree and the Dodo bird, and of a mysterious branching pattern in New Zealand trees that most likely represents a self-protective measure against recently extinct moa species. These relationships are the subject of lively debate among researchers, and Barlow gives us blow-by-blow descriptions. We learn of the food processing strategies of foregut and hindgut animals—we even see Barlow herself counting seeds entering and leaving these animals! There is a fascinating discussion of the role of geophagy—clay eating—in detoxifying foods, with Barlow pointing out that humans, especially children and pregnant women, as well as elephants, zebras, and horses, still seek to satisfy this primeval urge at times.

Strange hypotheses turn up in Barlow's travels down this path of ideas, but they all have claim to the ring of truth and they are all worth investigating.

Most important, if the anachronistic hypothesis is correct, it has implications for both ecological theory and conservation practices. For example, plants bereft of dispersers are limited in their range. They may have formerly contributed in important ways to the diversity of, say, a forest. Indeed, as ecologist Richard Corlett says, the "loss of dispersal agents may, in the long term, be as serious a threat to tropical plant diversity as deforestation" (p. 211).

Fortunately, science is a creative enterprise, for the reconstruction of evolutionary and ecological history requires imagination—imagination tempered, of course, by deep understanding of existing ecological mechanisms and the fossil record. The historical vision conjured up by Daniel Janzen and Paul Martin informs the present and suggests important strategies for the future management of finite biological resources. The great insight of these creative scientists is that extant organisms live not only in ecological time but also in evolutionary time. Understanding those organisms—and those now alive—requires an understanding of evolutionary history, which Connie Barlow's work supplies.

JOHN BOIS
AP Biology Teacher
Northwestern High School
Hyattsville, MD 29782

MARKET-BASED CONSERVATION: IRONIC, OXYMORONIC, AND PLAUSIBLE

Nature and the Marketplace: Capturing the Value of Ecosystem Services. Geoffrey Heal. Island Press, Washington, DC, 2001. 203 pp., illus. $50.00 cloth (ISBN 1-55963-785-1); $25.00 paper (ISBN 1-55963-796-1).

Nature and the Marketplace is a mixed blessing. Although it contains little that is new, few books have synthesized the literature on sustainability and markets as forthrightly and, more important, at a level of complexity conducive to undergraduate as well as graduate studies. It comes from a reputable source in the depths of neoclassical economics, which is a compliment not only to Geoffrey Heal but also to the ecological economists whose labors are bearing fruit in the contested terrain of sustainability studies. It represents a limited, market-oriented perspective on sustainability, but then Heal doesn't claim to have all the answers.

Heal's goal is "to share a vision of how humans can manage their interactions with the natural environment on which their prosperity and well-being are ultimately based" and to "examine how natural systems and processes benefit human societies and seek to identify the economic policies and institutions needed to maintain their integrity" (p. x). In public policy circles, Heal's work would be classified as public choice theory. Public choice theorists analyze policy under the assumption that human beings are self-interested utility maximizers and that maximization may be measured economically. They support the free market as the dominant form of socioeconomic organization, and privatization is the natural prescription.

For those who have become cynical about free-market approaches to environmental problems, *Nature and the Marketplace* is somewhat refreshing. Heal begins with an overview of the ecological underpinnings of the human economy rather than discussing them in passing, like so many others. He states, "The scale of the human endeavor has grown so large that it is affecting even basic planetary systems that have been in existence for hundreds of millions of years" (p. 4). Heal even takes a step further than most of the ecologists who write about ecological deterioration by specifying that "it is these complex systems that human *economic* activity is now, for the first time, affecting significantly" (emphasis added; p. 5). Ecologists tend to shun the word "economic," which conceals the fact that solutions must be sought in the *economic* policy arena.

Chapter 1, on the ecological foundation of the human economy, draws heavily on Daily's (1997) *Nature's Services*. Heal's overview is so basic that many ecologists would overlook the necessity of composing it. That, however, is their oversight and to Heal's credit, because students entrenched in economics curricula need just such a basic overview. Chapter 2 complements chapter 1 by providing an equally basic overview of market principles that will be useful to ecologists and natural resource policy students hoping to enter the all-important economic policy arena.

Chapter 3 is where Heal begins to synthesize and, unsurprisingly, where weaknesses begin to appear. Some of these weaknesses are common even in the nonsynthesized writings of economists and ecologists, however, and do not negate the value of *Nature and the Marketplace* as an introductory text on sustainable markets. The first weakness appears as a bias toward privatized market interests. Heal does a fine job of describing how New York City—more specifically its public water agency—invoked market forces in conserving (to some extent) its watershed. In other words, he demonstrates how a public agency can function in the market. Inexplicably he summarizes, "It may be possible to *privatize* the conservation and management of watersheds by giving corporations the right to manage them and sell the water they provide" (emphasis added; p. 60).

A more serious weakness surfaces in chapter 4, which places a great amount of hope in ecotourism as a replacement for extractive economic activities. This is where Heal's shortcomings in ecological economics appear. By employing the concept of trophic levels (as existing in the economy of nature), it becomes clear that increasing levels of tourism ultimately require increasing levels of agricultural and extractive activities (Czech 2000). In other words, at the base of a cash economy, agricultural surplus must be produced to free the hands for the division of labor and for the doling out of