in 1874), who created a systematic classification of vegetation around the enduring metaphor of the plant community as a living "superorganism" that arises and develops through predictable phases (succession) into a mature form (the climax formation). To Victor E. Shelford, the senior animal ecologist in the country before the Second World War, fell the task of integrating animal communities into Clements's classificatory scheme. In 1939 this culminated in the publication of *Bio-Ecology*, co-authored by Clements and Shelford. Within a decade, the grand ecological vision embodied in this work would be eclipsed by a new generation of ecosystem and population ecologists motivated as much by mathematical theory as by empirical observations gathered in the field.

Robert Croker, who teaches environmental law and conservation at the University of New Hampshire, has produced a relatively short, and most readable, biography of Shelford, chronicling his long career at the University of Illinois. Having been trained as a physiological zoologist at the University of Chicago (Shelford was fascinated with the natural history of tiger beetles), he moved to Illinois in 1914, where he remained for the rest of his life.

Shelford was best known for the vast amount of descriptive information about the plant and animal communities of North America published in numerous papers and several books. Among his students he is fondly remembered for the military precision with which he organized extensive field expeditions each summer. These cross-country ventures exposed a whole generation of budding ecologists to the diversity of natural habitats that were the real love of Shelford.

This biography is organized by themes: Shelford's scientific development at Chicago, his life-long career at Illinois, his challenging collaboration with Frederic Clements, his Continental travels with students, and his role in the developing conservation movement through the Ecological Society of America and the National Park Service.

While this biography focuses more narrowly on the life of Shelford, it identifies, but does not fully engage, two broader issues. Despite his empirical and pragmatic inclinations, why did Shelford (like so many of his colleagues) fall under the dominant spell of Clements's "superorganism" metaphor for the natural community, and what caused this paradigm to change so dramatically between 1940 and 1950? Equal interest surrounds Shelford's failure, during the same decade, to move the more conservative leadership of the Ecological Society of America to an activist role on behalf of conservation in this country. This subsequently led to the creation of the Ecologists' Union, the first $300 check for which was written by Shelford in 1945. Five years later the organization was renamed The Nature Conservancy, which is today one of the largest private conservation organizations in the world. *Pioneer Ecologist*, with its clear narrative and extensive footnotes, provides a fine point of embarkation for future explorations of these issues.

"The Easter field trip to Reelfoot Lake, Tennessee, in 1937. [Victor] Shelford (wearing the hat) is with Jane Dirks and Eugene Odum." [From *Pioneer Ecologist*; courtesy of Eugene Odum]

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Elephants and Forerunners

Mammoths, Mastodonts, and Elephants. Biology, Behavior, and the Fossil Record. GARY HAYNES. Cambridge University Press, New York, 1991. xii, 413 pp., illus. $49.50.

These are difficult days for African and Asian elephants. The effects of poaching, drought, and habitat encroachment by humans have reduced the number of African elephants (*Loxodonta africana*) from 1.3 million to 650,000 in the last decade. Fewer than 50,000 Asian elephants (*Elephas maximus*) remain. Yet these two species themselves are really just stragglers, surviving remnants of a much greater diversity of elephant-like animals that perished 10,000 to 11,000 years ago, at the end of the Pleistocene period. The extinction killed the woolly mammoth (*Mammuthus primigenius*) in Eurasia and North America, the columbian mammoth (*M. columbi*) and American mastodont (*Mammut americanum*) in North America, three species of gomphotheres in South and Central America, and an African species of *Elephas*. The cause of this extinction has long been controversial. Some camps blame dramatic climate shifts at the end of the glacial period, and others argue that human hunting was responsible. The goal of *Mammoths, Mastodonts, and Elephants* by Gary Haynes is to study "the ecology and behavior of modern elephants to create models for reconstructing the lives and deaths of extinct mammoths and mastodonts."

Modern elephants have complex social lives. Related adult females (mothers, daughters, sisters, and cousins) and their young offspring live together in groups. Each group is led by an elder female, who through the years has gathered extensive knowledge about sources of food and water in times of adversity, when to begin migrations or daily travel, how to avoid predators, and so on. Young males are ejected from groups when they reach sexual maturity; they may cluster together to form bull herds. Adult bulls generally live alone, but consort with female groups for breeding.

The book documents the profound influence of this social organization on elephant mortality in Hwange National Park, Zimbabwe. During droughts, elephants congregate around water holes, and they even dig wells when natural water sources dry up. Haynes discovered that juveniles and adult females are the primary victims of drought. Apparently bachelor living gives adult males greater mobility, increasing their access to scarce food and water. Likewise, when park officials decided to reduce the elephant population by 9000, they shot entire family groups, creating bone heaps dominated by adult females and calves. In contrast, when hunting elephants without the benefit of numerous high-powered rifles, African people usually target isolated adult males, because attacking family groups is too dangerous. Natural predators, such as lions and hyenas, can only kill naïve young males who have recently been thrown out of family groups.

Several chapters are devoted to long-term comparative studies of bone modification, articulation patterns, and popula-

tion age structure at water hole and hunting death sites. From these actualistic studies, Haynes develops models for interpreting patterns of mastodont and mammoth mortality. However, these actualistic studies only provide useful models if mastodonts and mammoths had behaviors and social structures similar to modern elephants, a contention for which Haynes presents little strong evidence. Though a case can be made for similarity between mammoths and living elephants, due to their close phylogenetic relationship, mastodonts are more distantly related to living elephants, and they might have had very different behaviors and social structures. Ultimately, mastodont and mammoth behavior must be reconstructed not by mere analogy to modern elephants but through rigorous study of evidence from the fossils themselves, including biochemical, geochemical, and structural attributes.

With data in hand from modern elephants, Haynes turns to the fossil record, broadly surveying global patterns in elephant, mastodont, and mammoth sites. This review is iconoclastic and, I believe, overly biased by the author's experiences with butchery practices at the Hwange mass kill sites. Yet the survey highlights the fact that unambiguous, well-studied butcher sites are very rare. It also offers an important English-language overview of the many spectacular Eurasian mammoth sites excavated over the past century.

The book closes with a discussion of climatic and hunting hypotheses for the late Pleistocene extinction in North America. Given the uncertainties about mastodont behavior and the lack of butcher sites with multiple individuals, mastodonts do not figure into Haynes's discussion. The dozen or so Clovis sites with multiple butchered mammoths present a paradox. Most sites are located near water sources and have age structures similar to those of African elephant die-offs during droughts. And though these mammoths were clearly butchered, they show no evidence of thorough carcass utilization, as is seen in African butcher sites. Haynes proposes that at the end of the Pleistocene, mammoths were clustering around water holes during a period of extreme environmental stress caused by the shift to a post-glacial climate. They were in poor physical condition and thus were easy targets for opportunistic human hunters. However, because of their poor condition and their abundance, humans did not carefully extract all available resources from each carcass. Environmental stress set mammoths up for extinction, but it was human predation that ultimately pushed them over the brink.

The book is well written, with illustrations and tables provided to support important conclusions. The bibliography alone is an excellent resource, and many researchers will use the information on growth patterns and age determination provided in the appendix. This book does not purport to solve the mystery of late Pleistocene extinction. It does offer a reasonable scenario for mammoth extinction that is consistent with the wealth of new information provided concerning modern elephant behavior and mortality.

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Vignettes: Our Universities

One of the things that concerns me is the persistent tendency to emphasize too heavily . . . the importance of relationships between universities and industry as a means of getting ahead competitively. The validity of this linkage is far from clear. If universities are really the key . . . , why did we grow faster than other countries during the late nineteenth and early twentieth centuries when our universities were mediocre, and why is our productivity lagging behind other nations now that our universities and their scientific achievements lead the world?

—Derek Bok, in *The Changing University* (Dorothy S. Zinberg, Ed.; Kluwer Academic Publishers)

The university . . . like most other organizations, . . . wants first of all to survive. The university has become adept at survival, to the point that it is not always clear whether the great range of activities in which many universities are engaged today represents a deep ideological commitment or simply a manifestation of the need to survive.

—George Bugliarello, in *The Changing University*

Structures and guidelines have been built by universities; but more importantly, the visceral fears that outside commercial interests would distort the search for truth, would taint academic freedom, have all but disappeared. It is not that those fears and conflicts do not exist; but in a world where there is constant interchange of manpower and money between academia and commerce, no one much protests publicly anymore.

—Robert Teitelman, in *The Business of Biotechnology: From the Bench to the Street* (R. Dana Ono, Ed.; Butterworth-Heinemann)

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