

BOOK REVIEW

Hominin Environments in the East African Pliocene: An Assessment of the Faunal Evidence



René Bobe, Zeresenay Alemseged, and Anna K. Behrensmeyer, Editors
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This volume grew out of two workshops (Tempe, Ariz., in 2003, and Washington, D. C., in 2004) that brought together scientists who have explored the East African environmental context during the millions of years in which hominins—including our ancestors—evolved. The community of people doing this kind of work is relatively small, in part because it requires long intervals of walking under a tropical Sun looking for outcrops that contain suitable numbers of fossils.

Few sites are excavated because the density of fossil remains in undisturbed sedimentary rock is usually too low to make such an effort worthwhile. Nature comes to the fossil hunter's aid by concentrating bones in sites favored by erosion. The most promising of these sites are then explored by surface grid surveys that carefully document the overall context in which the fossils occur, in order to determine the physical (sedimentary), geochemical, and biotic processes that left the deposits. In the end, this meticulous work yields vital clues to critical questions: When and where did our species evolve? And how?

Andrew Hill (chapter 1) comments on what can and cannot be learned from archaeological investigations. In Africa, by far the major problem in improving the state of knowledge is the sparse fossil record in time and space. While fossil sequences cover intervals of time that span a few thousand to several hundred thousand years, the full history of hominins spans millions of years. In space, most of the fossil finds come from the East African rift valley, leaving much of the vast African continent and its hominin history unknown.

Behrensmeyer et al. (chapter 2) describe the major levels of archaeological analysis: (1) collecting and analyzing fossils; (2) relating the fossils to the local paleoenvironmental context at the time of deposition; and (3) linking the local context to larger (pan-African or global) climatic conditions. This chapter also considers a wide array of potential problems that affect interpretations of the fossil record: preservation

biases, uncertain stratigraphic contexts, and time averaging of sequences that may have been deposited under widely differing environmental conditions.

Potts (chapter 3) summarizes three views of ways in which hominin evolutionary responses might (or might not) have been tied to climate: (1) changes that occurred at times of no climate change; (2) changes that occurred when climate shifted to a new state; and (3) changes that occurred because of the onset of larger climatic variations. Elizabeth Vrba's "turnover pulse" hypothesis, a prominent example of the second view noted above, features prominently early in this volume. In 1995, Vrba proposed that mammalian faunas in Africa shifted toward species types adapted to more arid conditions nearly 2.5 million years ago when large ice sheets first appeared in the Northern Hemisphere. She suggested that this shift would have altered hominin interactions with mammals and thus would have altered our ancestral evolution.

Several chapters early in the book compare trends in large mammal fossil remains against Vrba's hypothesis. Chapter 3, by Frost, on nonhuman primates, and chapter 4, by Lewis and Werdelin, on large carnivores, find evidence contrary to the turnover pulse hypothesis. Chapter 5, by Cooke, on suid (pig) dentition, and chapter 6, by Bobe et al., on bovines (hoofed mammals), detect significant changes at the time of Vrba's proposed turnover pulse, but these authors also detect other changes at times that Vrba's hypothesis did not anticipate. Many quantitative trends documented in these chapters seem sufficiently subtle to make me wonder if an order-of-magnitude increase in the amount of data collected might rewrite some of the conclusions.

Two chapters (Alemseged et al., chapter 7, and Eck, chapter 8) examine fossil collections made by two groups working in the same valley and on the same geologic unit but working in different areas to test for biases caused by varying collecting techniques. Inevitably, some differences in the representation of fossil groups emerge, though the overall agreement seems encour-

aging. Most discrepancies seem to be explained by spatial variations among outcrops and by the amount of time a group spent collecting fossils. Later chapters (9–12) focus on specific regions in Africa and on other problems inherent in interpreting collected remains. As a nonspecialist, I came away with the general impression of scientists working hard to test alternative interpretations of the data they (or others) had found.

As for possible links between changes in fossil types and regional environmental conditions in Africa and changes in global climate, several chapters note the possible effect of the first appearance of large northern ice sheets, around 2.75 million years ago, as proposed by Peter deMenocal. DeMenocal found that African dust fluxes at that time began to vary at the same 41,000-year cycle as the ice sheets, and he interpreted this link as an index of periodically increased African aridity driven by northern ice sheets.

Recent evidence, most of it published since this book went to press, points back to an earlier explanation for aridity changes in Africa. Most precipitation in northern Africa falls during summer, in response to the wet tropical monsoon driven by intense seasonal heating from the overhead Sun. In 1981 and afterward, John Kutzbach suggested that past fluctuations in the summer monsoon were driven by 23,000-year (orbital) variations in low-latitude solar heating. Convincing evidence that this aridity tempo remained dominant throughout the past 2.5 million years has recently been found in Pliocene lake sediments interbedded with dated lavas and in thick Pleistocene lake sequences cored by the International Continental Scientific Drilling Program.

These new results from field studies and drilling suggest that African hominins evolved in a climate in which summer (and annual) aridity was controlled largely by orbitally driven changes in the local monsoon, not by remote glacial overprints. At this point, past records of monsoon fluctuations are too limited to determine whether or not the monsoon fluctuations show a longer-term trend toward a wetter or drier climate. As a result, the possibility of a link between hominin evolution and climate remains unsolved.

In summary, this book provides valuable insights into the way archaeologists attempt to unravel human history and the daunting problems they face. Although written largely for specialists, the volume will also be of interest to those who are curious about the origins of our species.

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