



Profile of Melinda A. Zeder

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Of the accolades awarded to archaeologist Melinda Zeder, only one hangs on her home office wall. The 1964 Wendy Emeny Award, given by the Greenwich Academy to 12-year-old Zeder, recognizes her “outstanding character and enthusiasm.” It is the only award she received during her elementary and secondary education, she says, but it occupies a place of honor on her wall and on her curriculum vitae. “Enthusiasm,” she says, “is a character trait that, perhaps more than anything else, has stayed with me and, indeed, propelled me through my entire career. It remains with me to this day.”

Her enthusiasm has taken her from shepherd’s tents in Iran to the attics of the Smithsonian Institution, searching for clues to the development of human civilization. Zeder, a recently elected member of the National Academy of Sciences and senior scientist at the National Museum of Natural History, studies the animal bones recovered from archaeological sites to uncover key historical transitions as humans made the shift from foraging to urban dwelling.

Inspiration from Her Mother

Melinda Zeder was the fourth of five children. Her father’s eclectic career included stints as a fighter pilot, entrepreneur, venture capitalist, tour boat operator, and hula

instructor. He also served in the administrations of three United States presidents. Her mother’s interests, however, lay in history. While raising her children, Zeder’s mother wrote a novel set in Ancient Egypt at the time of the pharaoh Akhenaten. Zeder recalls peeking at stacks of archaeological reports from Tell el-Amarna, Akhenaten’s capital, collected by her mother to aid her research.

Although the completed book remains unpublished, her mother’s work gave young Zeder a deep fascination with archaeology. During high school, she joined a dig in Taos, New Mexico, and read the writings of anthropologist Leslie White. She posted quotes from White’s books on her bedroom wall. “Where other people had pictures of the Beatles,” she says, “Leslie White was my rock star.”

Zeder attended the University of Michigan, where White had taught for 29 years. After her sophomore year, Zeder signed up for a class entitled “Museum Techniques,” in which archaeology students assisted with various ongoing research projects. The course coordinator, Henry Wright, asked Zeder about her interests. “I’m going to be a Near Eastern archaeologist,” Zeder told him. “I’ve known that for the last 10 years.”

Wright, a Near Eastern archaeologist himself, helped Zeder shape her coursework toward that goal. He placed Zeder in the zooarchaeology laboratory, working with material he had brought back from Iran. Zeder developed a talent for identifying the species of small fragments of animal bones recovered from archaeological sites. “I’d always envisioned I’d do languages and digging up pottery and studying cuneiform and so on,” Zeder says, “but it turned out that I found that I just had a real affinity for this kind of work.”

Zeder recognized that zooarchaeology represented a largely unexplored research niche, especially in studying periods that saw the rise of cities and civilization. Near Eastern archaeologists had extensively studied languages and artifacts, but few had examined animal bones. “I think the attitude was: We know what they ate from the texts, and domestication happened long before the rise of cities, so why worry about a bunch of broken sheep and goat bones?” she says. “To me, this seemed to be a huge lost opportunity.”

Trekking Through Iran

Zeder accompanied Wright to Iran in 1973. Her honors undergraduate thesis (1) helped determine whether a domestic animal could be distinguished from a wild animal based on the orientation of bone hydroxyapatite crystals. She spent her 21st birthday at a nomadic encampment, purchasing sheep for her study. The team butchered and ate the sheep and prepared the bones for transport back to the United States, but not before saving a delicacy for Zeder’s consumption. “I had to eat an eyeball,” she recalls.

Her dissertation research (2) at the site of Tal-e Malyan in southeastern Iran investigated the insight provided by animal bones into urban economies. Subsistence economies consisted of individual families producing their own food. Urban economies, however, relied on specialized groups, with some raising animals and others butchering and distributing the meat. “These different components require some kind of either market system or state system to coordinate that and bring it all together. The study of animal bones from early cities helps us understand how this happened,” Zeder says.

As a Western, educated woman in Iran, Zeder was able to converse with both men and women under local custom, while her male colleagues were only able to talk with other men. Although political conditions caused her to leave Iran in 1978, she fondly recalls the warmth and generosity of Iranian villagers, nomads, and shepherders. “It stayed with me all my life,” she says.

Scouring the Smithsonian

Zeder completed her doctoral work while living in the Washington, DC, area, having moved to accompany her husband Jim Blackman, who had begun a postdoctoral fellowship at the Smithsonian Institution. Zeder completed a predoctoral fellowship at the Smithsonian herself, after the birth of her first child and before the birth of her second. Upon graduation, she launched Zooarchaeology Consultants, an archaeological consulting firm, and secured a contract to search the collections of the Smithsonian’s National Museum of Natural History for plant or animal remains included with other artifacts from archaeological sites. The materials



Melinda A. Zeder. Image courtesy of Chip Clark (Smithsonian National Museum of Natural History, Washington, DC).

This is a Profile of a recently elected member of the National Academy of Sciences to accompany the member’s Inaugural Article on page 3191 in issue 11 of volume 112.



Zeder measuring bones from the 11,700-year-old Hallan Çemi site in southeastern Turkey as part of a study. Image courtesy of Reuven Yeshurun (University of Haifa, Mount Carmel, Israel).

were spread over many other collections, so she worked her way through countless drawers in the museum's attic and basement spaces. The archaeobiology collection turned out to be, in her words, "absolutely gigantic." Now cataloged and included in the Smithsonian's research database, the archaeobiology collections have become some of the most heavily used archaeological collections curated by the Smithsonian. Zeder considers her role in locating and cataloging the collection "one of the greater accomplishments of my career."

Zeder moved into an administrative position at the National Museum of Natural History in 1989. With the help of Archaeology Division Head Bruce Smith and then-Secretary of the Smithsonian Robert McCormick Adams, Jr., himself an archaeologist, she successfully lobbied for the creation of an archaeobiology curatorial research position, which she secured in 1992.

Markers of Domestication

To process large volumes of animal bones for her research, Zeder developed, in her words, "a Henry Ford approach" to handling and analyzing archaeological bone assemblages so that different parts of the process could be completed by students with varying levels of skill. In the mid-1990s, Zeder happened

to pass by the table of a student working with animal bones from a 20,000-year-old predomestication site in Iran. Zeder noticed large bones of sheep and goats, thought at the time to be typical of the predomestication Paleolithic period, but also small bones of the same animals, characteristic of Bronze Age domesticates. Previously, archaeologists had interpreted a decrease in animal body size as a definitive indicator of domestication. The presence of two different body sizes in the assemblage led Zeder to reexamine body size as a domestication marker, an investigation that grew into more than a decade of research on domestication in both plants and animals.

Her research not only focused on archaeological and genetic biomarkers of domestication in both plants and animals but also sought to refine the temporal and geographic context of initial domestication and agricultural origins in the Near East and explore the reasons why humans and their plant and animal partners embarked on pathways that led to domestication and agriculture worldwide.

Her Inaugural Article (3) summarizes the progress she and others have made in exploring the central questions surrounding domestication. Zeder defines domestication as one organism assuming care for another to increase the predictable supply of a resource, while affording the domesticate advantages over wild organisms. She examines the impacts on both domesticates and domesticator, listing both genetic and phenotypic changes. A third category, "plastic" impacts, is related to genetic and phenotypic markers but encompasses related effects such as zoonotic transfer of pathogens from animals to humans and an increased prevalence of dental caries in humans due to a carbohydrate-rich agricultural diet. Changes in animals' cultural roles, she holds, can also serve as domestication markers. Zeder notes that all markers together tell the story of the developing mutualistic relationship between humans, plants, and animals, with no one marker taking priority over the others.

Theories explaining the origin of domestication can be categorized as either "push" or "pull" theories. Push theories state that external environmental pressures pushed humans toward domestication as a survival strategy, and pull theories state that humans in relatively abundant conditions deliberately reshaped their environment through

domestication. Investigating the question of domestication origins, Zeder writes, will likely benefit from side-by-side comparison of domestication markers in various regions, evaluated empirically. "Domestication and agriculture are primary factors responsible for the increasing role humans play in driving Earth systems, ushering in the Anthropocene," she says. "Understanding how and why humans embarked on this course so long ago takes on special importance and even urgency for understanding how we navigate the challenging course we have set for ourselves in the future."

Addressing Grand Challenges

Last June, Zeder stepped away from her day-to-day museum duties for a three-year capstone sabbatical. Before leaving, she completed the analysis of a large assemblage of animal bones from southeastern Turkey that may offer insights into the first steps toward animal domestication nearly 12,000 years ago. She also oversaw the final stages of a 30-year project to document and catalog the Smithsonian's archaeobiology holdings. Further, she curated a long-term exhibit titled *Eternal Life in Ancient Egypt* that she hopes would have passed muster with her Egyptologist mother.

She and her husband Bruce Smith moved to New Mexico to complete book-writing projects. Their home outside Santa Fe sits amid what she calls a "beautiful, stark, wonderful environment." Community events, she says, attract cowboys, artists, and physicists alike.

Reflecting on her career, Zeder notes that zoological remains in archaeological research are viewed differently now than when she first began studying archaeology. "Animal bone analysis and plant remains used to be confined to a list of species relegated to an appendix," she says, but today, the study of animal remains from archaeological sites can be seen as relevant to nearly every one of the grand challenges in archaeology (4).

"Animals intersect so tightly with so many different aspects of people's lives—not only what they eat but their pets, their companions, their traction animals, symbols of power, and symbols of religious identity—that they provide an avenue to understand almost all of those different aspects of human existence," she says. "And that's one of the enduring excitements of the field."

1 Zeder MA (1978) Differentiation between the bones of caprines from different ecosystems in Iran by the analysis of osteological microstructure and chemical composition. *Approaches to Faunal Analysis in the Middle East*, eds Meadow R, Zeder MA (Harvard Univ, Cambridge, MA), Peabody Museum Bulletin, No 2.
2 Zeder Melinda A (1985) Urbanism and animal exploitation in southwest highland Iran 3400–

1500 B.C. PhD dissertation (University of Michigan, Ann Arbor).

3 Zeder MA (2015) Core questions in domestication research. *Proc Natl Acad Sci USA* 112(11):3191–3198.

4 Kintigh KW, et al. (2014) Grand challenges for archaeology. *Proc Natl Acad Sci USA* 111(3): 879–880.