

In an office lab in west Philadelphia, Naomi Miller sits transfixed, peering through the twin barrels of a microscope. Around her is a sort of sarcophagus for long-dead plants and seeds, in phials and film canisters or mounted for reference. There are no exotic trophies or travel posters—just a death row of potted plants on the windowsill that look ready to join the specimens in steel cabinets. She pushes burnt seeds and splinters in and out of the field of view with a slender paintbrush, identifying and counting by species. She once told an acquaintance, half in jest, that the only reason she got into this line of work was that it was so boring no one else would touch it.

Out from behind the microscope, though, Miller's field of view is as panoramic as the vivid Near Eastern landscapes she has painted over the course of her career. For her research has given us, among other things, a clearer picture of the domestication of animals and plants over long reaches of time, and their effects on history and culture.

A lanky 53-year-old with a guileless look that shouldn't be mistaken for naivete, Miller is a senior research scientist at the University of Pennsylvania's Museum Applied Science Center for Archaeology. Her specialty is paleoethnobotany, aka archaeobotany, a discipline concerned with the surviving traces of plant materials used by humans in ancient times—seeds, charcoal, fiber, wood, pollen, and plant-generated silica. For some thirty years she has studied what humans and livestock ate and drank, what plant materials were used for clothes, tools, or construction, and how agriculture reshaped human culture.

Colleagues note her leadership in helping archaeology recalibrate its reckoning of human influence on ancient landscapes. Richard Zettler, curator of the University of Pennsylvania Museum of Archaeology and Anthropology, recently noted that Miller's "highly informative" work forced archaeologists to reexamine their interpretations of plant material. Ohio State University archaeobotanist Joy McCriston says Miller has been "connecting the dots, and making important contributions where she pulls it all together."

Some of the implications of the charred debris she has teased out of Near Eastern dirt extend the story even further—into our own future.

Archaeobotany was a relatively new field when Miller began her career in the late 1970s. At the time, most of the small number of practicing archaeobotanists remained in their labs rather than participated in excavations, but Miller went to southwestern Iran to work with a team of archaeologists at the site of the ancient Elamite city of Anshan (now Malyan). Her work, analyzing plant remains from the five-thousand-year-old urban setting, was interrupted by the Iranian revolution, which banished a generation of foreign archaeologists from the country. She left with her seed collections in her luggage, and with little hope of returning.

As a veteran of the Anshan expeditions, and as coeditor of a new book on Iranian archaeology, Miller was recently invited to speak at a conference in Tehran whose purpose was ostensibly to renew relations between Iranian and Western scholars. She had no illusions about what the Iranians were casting about for: a way to stimulate tourism. "It's so obvious...they are using us," she said on the eve of the trip. "They have their own agenda. Do I want to be a party to that? Well, if it's a cause I agree with—to improve relations, to maintain scholarly contact—I'll go." And she went, but her view of the Iranians' motives remained unchanged. Still, she is weighing fresh invitations to return to the country to work at Susiana, another Elamite-era dig.

The life of your average Near Eastern archaeologist can be trying: spending hours at a gritty, sweltering excavation, only to find that

nobody's been screening or sampling. Back at the lab, the mice have eaten all the labels. A shower might redeem some of this, but no one's bothered to fire up the hot-water heater. And the household has run out of vodka.

Such situations would try anyone's patience, but co-workers on various expeditions don't remember Miller as ever having been dispirited or moody. By all accounts she is an optimist—a sustaining presence when the conditions of the archaeological life wear on the spirit. She bakes desserts, sings the "Marseillaise" on Bastille Day, and plays the kazoo at birthdays. Then there are her drawings and paintings. "Naomi's artwork has always been a humorous commentary on the life at archaeological digs, and that helps relieve pressure," says Smithsonian zooarchaeologist

Seeds of Time

How one woman's knack for extracting history from plant remains led to some startling conclusions about ancient people and the environments that sustained them.

◆
by Steve Nash





Miller gathers a botanical sample in 1983 in Sardis, Turkey. She spent a few weeks traveling the country with a colleague before heading to an excavation at Kurban Höyük. "Even when I am a tourist I like to look at plants and add seeds and wood to my comparative collection," she says.

was pretty weak. But she just kept working on it, engaging everybody in conversations. It was amazing." That ease with strangers informed her research at Anshan. She arrived curious about the lives of both ancient and modern-day people, and ready to engage them both.

Archaeobotany often begins with the low-tech tedium of flotation—dumping soil samples into vats of water to separate and sieve out the materials of interest. (A few verities: bone sinks; seeds and charcoal float; plant remains are almost never preserved in dirt unless they're charred.) Flotation gleanings are examined under a low-power microscope and manually sorted and counted by species—maybe juniper or pistachio wood; wheat, trigonella, or camelthorn seeds.

In Anshan, Miller was soon charting the shifting ratios of charcoal and seeds, as registered in strata deposited over thousands of years. At the time, burnt seeds were interpreted only as the remains of spilled food. Here, the finds were puzzling: a preponderance of wild, nonfood plant seeds in a place where wheat and barley had been cultivated for thousands of years. Other questions emerged from the ashes: Why was the proportion of charcoal to charred seeds greater in 3000 than in 2000 B.C.? Why would Anshanites shift their sources of fuel like this as the centuries passed?

Following a hunch, Miller visited a nearby village to see how the locals lived. After all, what did a Michigan grad student raised in the Bronx know about rural life in the Near East? "I began to observe how plants were incorporated into what would become the archaeological record," she recalls. "How they got charred and disposed of—in a community without electricity, running water, or gas lines."

She soon learned that local cooking fires differed little from those of Elamite times. Animal dung was still used, and Miller began to wonder whether it might contain seeds. She discreetly scooped up some hearth sweepings to ship home. Lab analysis made it apparent that archaeologists had often been looking at the remains of animal diets rather than spilled human food. That explained the presence of so many wild plant seeds. It also suggested a

Melinda Zeder. "It's a way to capture our unusual life situations and the reactions of the locals to us."

Miller speaks excellent French, speaks and reads German, Russian, and Turkish well, and can handle Dutch and ancient Sumerian. She also loves to talk.

"She will talk to anybody about anything," says colleague Mary Voigt of the College of William & Mary. "She's unusual even among archaeologists, and we are a lot of talkers. I spent a week in Iran with her. At first, her Persian

Below, and top, next page: panels from "A Day at the Dig," one of Miller's paintings. Some panels portray aspects of how material was excavated and processed at Gordion, Turkey, in the summer of 1996, while others are more general depictions of everyday events at big digs in the Near East.





reason for the increasing ratio of seeds to charcoal over time: Wood became scarcer and more remote as nearby forests were relentlessly cleared for fuel and pasture, and as Anshan's population increased.

Her findings are now widely accepted as applicable to many other Near East sites. Moreover, those prosaic bits of charred wood and seeds helped to raise some basic questions about whole landscapes and the cultures they sustain.

Plant remains reflect the impact of population growth, agriculture, and local industry on the environment. They record how pasture quality deteriorates under grazing pressure and how forests vanish, their trees hewn down for timber and fuelwood. The depth of valley erosion sediments illustrates how quickly such denuded hills lose productive soils, which explains why, in many places, the trees did not return. Degraded pastures and deforestation mean less food and fuel, altering the survival options for the inhabitants.

Miller, says Voigt, "is putting people back into issues of environmental change, where they should be and where, increasingly, we think of them today. We have not thought that way about the deep past. She is a leader in shifting that emphasis from climate to people." Climate change—such as catastrophic drought and flooding—has often been seen as the culprit.

In a chapter from a forthcoming book on the archaeology of global change, Miller says it is difficult to chart climate fluctuations in the ancient Near East by using plant remains because farming and industry altered the vegetation so dramatically that the climate "signal" in the archaeological record is all but erased.

Miller has sometimes challenged the scenarios put forth by other archaeologists. In 1997, she published a response to what she termed the "Great Near Eastern Drought Theory," which had been presented by a team of archaeologists led by Yale's Harvey Weiss. The team had concluded that an abrupt and devastating drought caused

the collapse of the Akkadian empire in 2200 B.C., ending four centuries of urban life at Tell Leilan, in southern Mesopotamia.

Miller wrote that Weiss's soil samples, which indicated increasingly arid conditions, did not square with plant remains from the region that show healthy rather than drought-stricken forests at the time. She also argued that humans would have been resilient enough to switch to drought-resistant crops, and there was no evidence in seed collections that they had done so. "Once you get people interfering with the vegetation on a large scale, all bets are off," she says now. "Starting in the third millennium, human impact on the environment swamps climate influence in much of the Near East."

Miller also does not subscribe to the theory put forward in the popular 1999 book *Noah's Flood: The New Scientific Discoveries About the Event Which Changed History*, by Columbia University geologists William Ryan and Walter Pitman. They argue that between 6200 and 5800 B.C. a prolonged drought drove most of the inhabitants of the Near East to abandon their settlements and flee north to

Naomi Miller



The remnants of animal waste, traditionally used for fuel, often yield evidence of ancient environments. In the village of Cümcüme in southeastern Turkey, dung cakes are made of cow dung mixed with straw, clay, and water, then shaped by hand or with a circular mold.



Cloth-encased samples culled from flotation hang to dry in Miller's field lab at Gordion, Turkey. Once dry, samples wait for Turkish government approval to leave the country for analysis in the U.S.

The narrow coastal plain on the south side of the Black Sea lake, she says, had little arable land, and its human population would have been foragers and fishers. The flood would only have driven this small group as far as the nearby uplands, and "there is no evidence for an influx of people into northern Mesopotamia and surrounding regions, which is characterized throughout this period by a high degree of cultural continuity in agricultural practices," she adds. As for Gilgamesh and Noah, the annual floods along the Tigris and Euphrates provided abundant material for legend, and they are much nearer at hand than the Black Sea.

Perhaps the most prominent scholarly dustup so far occurred in 1996 when Miller wrote an article questioning the results of a survey of botanical evidence at the eleven-thousand-year-old Abu Hureyra site in what is now northern Syria, which involved decades of research by the British archaeobotanist Gordon Hillman. His team had interpreted the mixes of several species of seed concentrations as evidence that humans had harvested a variety of wild plants—a kind of prelude to agriculture. Miller suggested those seed concentrations might be burnt gazelle dung. Gazelle were fairly common at the time, and a known source of meat. Detailed counterpoints from both sides ensued.

Over time, the accumulation of evidence in each of these cases will tilt the scales toward or away from Miller's conclusions—or someone will suggest a new idea. More recent research by Columbia University paleoclimatologist Peter deMenocal, for instance, may have bolstered the case for the Great Near Eastern Drought Theory. As for the source of the seeds at Abu Hureyra, Miller says, "I still think it's gazelle shit."

the shores of the Black Sea, at the time a vast freshwater lake. A civilization prospered there for 300 years until a sediment dam separating the Mediterranean from the Black Sea gave way in 5500 B.C., opening the Bosphorus Strait. The resulting flood forced the abandonment of the Black Sea settlements. The inhabitants returned south to the Near East, where their suffering was memorialized by the Sumerian epic of Gilgamesh, and, later, by the tale of Noah's Flood.

Miller says she is "agnostic" about how the Bosphorus was created, but she is not alone among archaeologists in finding the evidence for the rest of the Noah's Flood idea telegenic but unpersuasive. She says that environmental degradation may well have caused a general abandonment of some sites at around 6000 B.C., but other settlements continued to be occupied and new ones were established.

Miller and colleague Linda Jacobs consult on the drawing of a burial at Malyan, Iran, in 1976. "I think of myself as an archaeologist with a speciality in archaeobotany," she says. "If I have time to spare from floating and botanizing, I'll volunteer to do other tasks."

Janet Turchi

William M. Sumner



In Yassihöyük, Turkey, Miller gets in on the festivities at a wedding celebration (the solemn newlyweds can just be seen in the center background). “I usually resist calls to join the dancing...but obviously not that day.”

The globetrotting Miller sounded more like an environmental activist when she wrote, “Human populations carry out their daily lives within a natural environment that has its own, sometimes unforgiving, qualities, and land use practices that favor short-term economic advantage over long-term, sustainable resource management may adversely affect later generations.” She’s more than a little uneasy about how our own civilization is doing on that score.

“History demonstrates,” she says with a self-mocking laugh at the grandiosity of the observation, “that the chances of something positive happening are actually pretty slender.” People should think long-term, like archaeologists, when they introduce ecological change: “I don’t think we should all become hunter-gatherers again. I accept modern industrial society, and I also think that everything changes—nothing’s going to stay the same. The trick is to slow down change, so if you do start seeing change you can actually have time to make the adjustment. It’s much easier to maintain the ecosystem than it is to repair it.... The problem is, most people in policy-making positions don’t care.”

Serendipity has given Miller a chance to influence the direction of environmental change on one landscape, in a way that may guide archaeological practices in times to come. For the past several years she has worked at the so-called “Midas Mound” at Gordion, in Turkey (“Celebrating Midas,” July/August 2001). Although the current excavators have concluded that it is not the tomb of King Midas, there is indeed a handsomely appointed burial chamber under the 460-foot-high mound.

Part of the mission of the Gordion expedition is continuing excavation and interpretation, and that involves Miller’s work. Among her findings is that as time passed, over-grazing by domestic animals caused a decline in high-quality forage.

The other component is conservation of the burial chamber and mound. Though conservation wasn’t, strictly speaking, Miller’s business, she got involved anyway. When she first arrived in 1988, the steep, loose soil on the surface had eroded more than fifty feet since first built, and deep gullies had developed. Bare and windblown in dry seasons, the unstable soil was visited by grazing goats, motorcyclists, and hiking tourists. There was concern that the surface damage could eventually affect the burial chamber deep within.



Laura Foss

Miller suggested building a protective fence around the mound, and she was pleasantly surprised when the government did so. After one rainy season, the lower slopes were transformed. Mud-brick erosion barriers were laid across the gullies—another Miller innovation—and the cracks between the bricks were sprinkled with native seeds. Now, more than 125 different species of native plants thrive. “The contrast between the fenced-in area and the rest of the landscape is unbelievable,” says Voigt, Gordion’s excavation director.

The Gordion “ecopark” combines Miller’s interests in archaeology and conservation and calls forth her talent for engaging the enthusiasm of others, including local villagers, a museum director in Ankara, and a Turkish investor who wanted to help protect his national heritage.

The project is simple, cheap, and a powerful education for the Turks—officials and goatherders alike. It displays an ecologically healthier landscape that has not been seen here in living memory, and perhaps not for a thousand years. It may not be in the job description for an archaeobotanist, but it suits Miller’s ideas about her occupation.

“The social value of archaeology,” she says, “is putting people in their place—giving them a sense that we are one little part of a very long continuum. It includes not just other humans. Things have happened before us and will happen after us. Basically, the social function of archaeology is to teach humility—and that we should pay attention.” ■

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