MAMMOTH TRUMPET

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CRP sale!
See inside rear cover

Mammoth Cold Storage

Fortunately for present and future scientists, Russia has stored mammoth remains in this chamber of the Xatanga ice cave in Siberia. This is one of the locations where Hendrik Poinar, director of the Ancient DNA Centre at McMaster University in Ontario, collected samples for nuclear and mitochondrial DNA studies. Dr. Poinar and colleague Dr. Ross MacPhee of the American Museum of Natural History discovered unexpected wrinkles in tracing the lineage of mammoths—in North America and on the other side of the Bering Land Bridge—and their cousins, elephants and mastodons. Part II of our series on decoding mammoth DNA starts on page 9.

DEBI POINAR

The Center for the Study of the First Americans fosters research and public interest in the Peopling of the Americas. The **Center,** an integral part of the Department of Anthropology at **Texas A&M University,** promotes interdisciplinary scholarly dialogue among physical, geological, biological and social scientists. The **Mammoth Trumpet,** news magazine of the **Center,** seeks to involve you in the peopling of the Americas by reporting on developments in all pertinent areas of knowledge.

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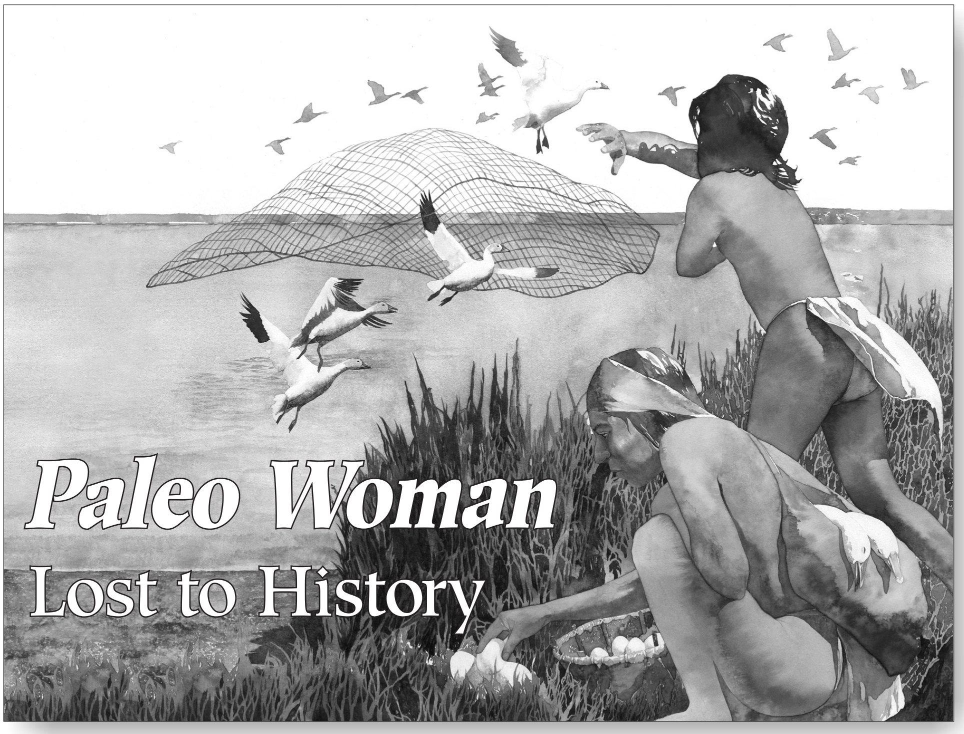


ILLUSTRATION BY MATTHEW FRY—WOOD RONSAVILLE HARLIN, INC.

INSIDE

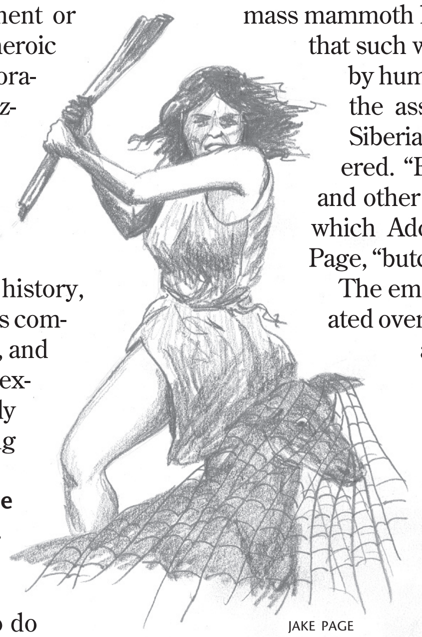
PALEO WOMAN is ancient history . . . except she isn't. Exactly what part she played in the prehistory of the Americas has largely been ignored, replaced instead by our preoccupation with mighty mammoth hunters and other male-dominated images. Yet Paleo Woman must have carried her own weight. What exactly was her role in the peopling of the New World? That's the question James Adovasio of Mercyhurst College and Elizabeth Chilton of the University of Massachusetts at Amherst have been asking. They have brain-teasing ideas about what Paleo Woman was up to all those thousands of years ago, and they have suggestions about how researchers might uncover new discoveries about women in the archaeological record.

How have the contributions made by women over the millennia managed to escape our attention in the first place? Dr. Chilton gives four reasons that she believes account for our overlooking the vital contribution made by Paleo Woman: our tendency to visualize Paleoamericans as adventurous explorers, the undue and possibly inaccurate emphasis we place on hunting, our fixation on stone tools to the exclusion of other cultural evidence, and the unbalanced ratio of male to female researchers in the field. We'll weigh the merits of her bill of indictment in this installment. After we investigate in part II Chilton and Dr. Adovasio's suggested changes in the way archaeologists do their job, perhaps

Paleo Woman will stand just a bit more upright in history.

Migration, not exploration: Who knew it was a New World?

History books glamorize crossing a continent or moving from one continent to another as the heroic and hazardous human enterprise of exploration. When we place Paleoamerican colonizers from Asia alongside Columbus, Lewis and Clark, and Neil Armstrong, Chilton says we're imputing motives that simply weren't there. These weren't Stone Age Vikings. They never set out to discover new lands for king and country. In recorded history, explorations are a race run by greedy nations competing to increase riches, territory, prestige, and power. But Paleo people weren't racing or exploring. Instead, says Chilton, they "were likely more concerned with making supper, finding a good marriage partner, deciding whether or not the group should split up, or what to do about the baby's cough." Moving was a matter of subsistence and survival, not an expedition.



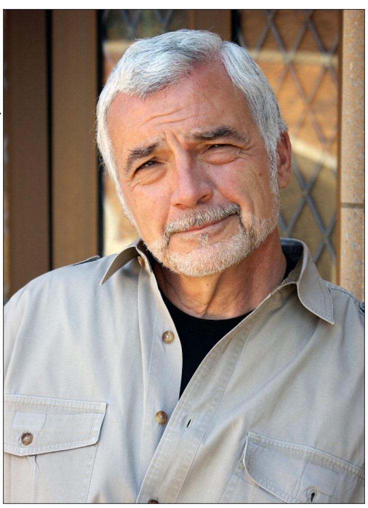
Paleo Woman's everyday life may have included activities we haven't considered.

JAKE PAGE

The trouble with equating Paleoamericans with explorers is that our vision is obscured by the stereotypical image of adventurers. This "advance party," as Adovasio calls the First Americans, is historically perceived as a group of men investigating beyond their known territory. There's the rub: men only. When the situation is perceived in this narrow field of vision, it excludes women and children and the elderly, everyone but these young male adventurers. The Americas weren't peopled by such explorers, but by prototypical pioneers, bands of individuals and families of both sexes and all ages, carrying with them bags and baggage, pets, everything they owned.

But this isn't the only part of paleo lives that has been sensationalized. Our insistence on hunting as the exclusive means of subsistence has also run amuck.

ELIZABETH CHILTON



J. M. ADOVASIO

Elizabeth Chilton and James Adovasio.

Man, the mighty "opportunistic forager": Thoughts on hunting are often overkill

Thrilling images of the Early American hunter cornering a now extinct predator or staring down a woolly mammoth have been found not only in what Adovasio terms "penny dreadfuls," but in such prestigious publications as *National Geographic* and even the *Smithsonian*. Once this was considered an accurate depiction, but today thoughts are changing. Adovasio calls it "ludicrous" that a group of hunters would take on a raging predator when there was other game, smaller and less lethal, to choose from. And as for mass mammoth kill sites, he says it's looking less and less likely that such wholesale slaughters were actually orchestrated by humans. In some cases stone tools are found among the assemblages, but in other sites across Eurasia, Siberia, and North America no stone points were discovered. "Even in those assemblages where stone points and other tools were found," we find in *The Invisible Sex,* which Adovasio coauthored with Olga Soffer and Jake Page, "butchering marks were few and far between."

The emerging idea is that these "boneyards" were created over long periods of time in places where weakened animals died. An example is the mineral lick at the Dolni Vestonice I site in the Czech Republic, which drew many different kinds of animals—not only mammoths—suffering from lack of nourishment and desperate to save themselves. When the mineral lick failed to prolong life and the animal perished, ready and waiting to dispose of the carcass were all manner of scavengers, including humans.

To Chilton this new image depicts Paleoamericans as "foragers who hunted and scavenged a variety of animals on an opportunistic basis." Among many modern hunter-gatherer peoples, foraging provides a large portion of the diet; hunting is likely to take place on a less life-threatening scale, with smaller, more manageable game as prey. Both Adovasio and Chilton discuss net snaring of small animals such as rabbits and birds, a kind of group hunting that among Paleoamericans probably involved not only women but the elderly as well, even children. Adovasio notes this method of hunting is supported ethnographically and by actual archaeological specimens or impressions of Upper Paleolithic/Paleoindian–era hunting nets recovered in both North America and Europe. The vision of the mighty mammoth dueling the Clovis hunter has held our imagination hostage long enough. Now seems a good time to kill outright that idea. It's the only man-made mass mammoth inhalation in history.

Stone tools: Not a girl's best friend

Hard on the heels of the overemphasis on hunting, nevertheless important in its own right as a distorting factor, is the disproportionate importance we place on data that come from stone tools. The problem with stone tools is that there is no problem. After all, they make up the majority of artifacts from the Ice Age and, as Adovasio admits, "they can exist in the ground for a long time."

Chilton says succinctly, "Stone tools are forever."

What isn't forever is perishable artifacts—baskets, cordage, fur, and other articles of organic material. The odds of objects like these lasting over an extended period of time are slim to none, and it only occurs, says Adovasio, in "extraordinary circumstances." What's more, he amplifies, these are the materials that were used "for the most part, it is assumed, by women." Further aggravating the situation is the sad fact that "not until recently were some archaeologists even trained to look for much else besides stone or bone tools, so they tended to miss . . . whatever evidence of the woman's role had survived."

Perishables notwithstanding (no pun intended), there's a bit of bias implicit in stone tools themselves. Besides the iconic mammoth, one emblem inevitably arises in any discussion of Clovis-age people, the Clovis calling card if you will. This is, of course, those beautiful fluted points that an archaeologist can spend a lifetime marveling over. The problem with fixating on these captivating discoveries is their tendency to cloud our vision and divert attention from the less glamorous stone tools and debitage out there. This is, of course, a trap that's difficult to avoid in any branch of archaeology. Who wants to study the rubble of the workmen's village when there are pyramids next door? Like the minutiae of the workmen's village, though, lesser lithics and debitage can divulge mountains of information to the insightful archaeologist prepared to invest the time to study them. Compared with all-important points, unfortunately, too often in the past the minor products of lithic technology were largely ignored. This means that humble tools like endscrapers and utilized blade flakes may have been entirely overlooked. It's a comfort to report that today's archaeologists are trained to scrutinize *all* objects found on an occupation floor. Chilton believes the debitage of every ancient site should be explored with a fine-tooth comb, and we can confirm that today that precept is nearly universally observed. [If you want to be reassured, read "Use Wear, Up Close" in this issue. –Ed.]

Furthermore, Chilton argues, "there is no compelling reason to argue against women making and using all kinds of stone tools."

Historically, not prehistorically: A paucity of female archaeologists gave us an all-male Pleistocene

Chilton's bold assertion that Paleo Woman may have had duties more vital and demanding than childbearing and cooking requires a cultural assessment to understand how Paleo Woman got swept under the rug. But it's our modern culture that we need to examine, not the ancient. Like most fields, archaeology is predominantly male for the simple reason that women, historically speaking, are relatively new recruits to the modern work force. We aren't trying to trace the tortuous chain of events that climaxed with women's suffrage and Rosie the Riveter, we're only dealing here with the *results* of centuries of male dominance. For starters, Clovis Man (natch!) first walked into modern consciousness in the early 1930s by way of Blackwater Draw and its famous points.

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Many years may pass between the time an important discovery is made and the acceptance of research results by the scientific community. To facilitate communication among all parties interested in staying abreast of breaking news in First Americans studies, the **Mammoth Trumpet,** a science news magazine, provides a forum for reporting and discussing new and potentially controversial information important to understanding the peopling of the Americas. We encourage submission of articles to the Managing Editor and letters to the Editor. Views published in the **Mammoth Trumpet** are the views of contributors, and do not reflect the views of the editor or **Center** personnel.

–Michael R. Waters, Director

Finding Traces of Early Hunters *beneath the* Great Lakes

ANDREW STEWART

▲ An *inukshuk* (stone cairn) commonly found in Arctic Canada.

JOHN O'SHEA

◀ A similar stone construction beneath Lake Huron; it has snagged the cable of the mini-Rover (as many others did in exploring the lake bed).

THE AMERICAS WERE COLONIZED during a period of environmental turmoil—fluctuating temperatures, advancing and retreating ice sheets, rising and falling sea levels. The changing sea levels are famous for exposing and submerging the Bering Land Bridge and for alternately exposing and flooding parts of the continental shelves along both the Pacific and Atlantic coasts. Less well known, but equally consequential for America's "Third Coast," is the rise and fall of the Great Lakes in time to the ups and downs of early-Holocene temperatures.

For years, archaeologists in the region have explored beach ridges far inland from modern lake margins for traces of the Paleoindians that lived here when the Great Lakes were even larger than today. Unfortunately, the shorelines of lakes from low-water periods lie submerged beneath the depths and are mostly inaccessible to researchers. Now scientists from the University of Michigan, using the same technology that an international research team used to locate the wreck of the RMS *Titanic,* are exploring the bottom of Lake Huron for traces of the late-Paleoindian and early-Archaic peoples that lived on these submerged landscapes. They have identified a series of apparently aligned or arranged boulders that are remarkably similar to ethnographically known caribou hunting structures.

BOTH: JOHN O'SHEA

O'Shea (*right*) and graduate student Eric Rupley ▲ retrieving a side-scanning sonar unit.

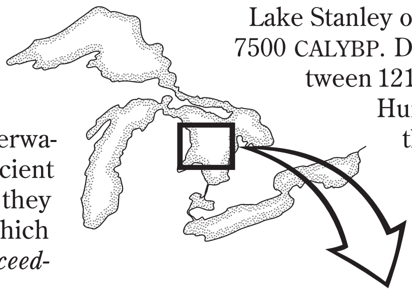
Meadows. ▶

The rise and fall of the Great Lakes

The Great Lakes rose and fell in response to a number of complicated factors including the influx of water from melting ice sheets and the outflow of water as retreating ice sheets unblocked outlets to the sea. In addition, the elevation of the land surface fell and rose as millions of tons of glacial ice alternately advanced and retreated. (The rising of land unburdened of the colossal weight of an ice sheet is known as "isostatic rebound.") As the northern lake margins rebounded with the retreat of ice the entire lake would sometimes shift southward, resulting in rising lake levels on the south shore and lowering lake levels on the north shore.

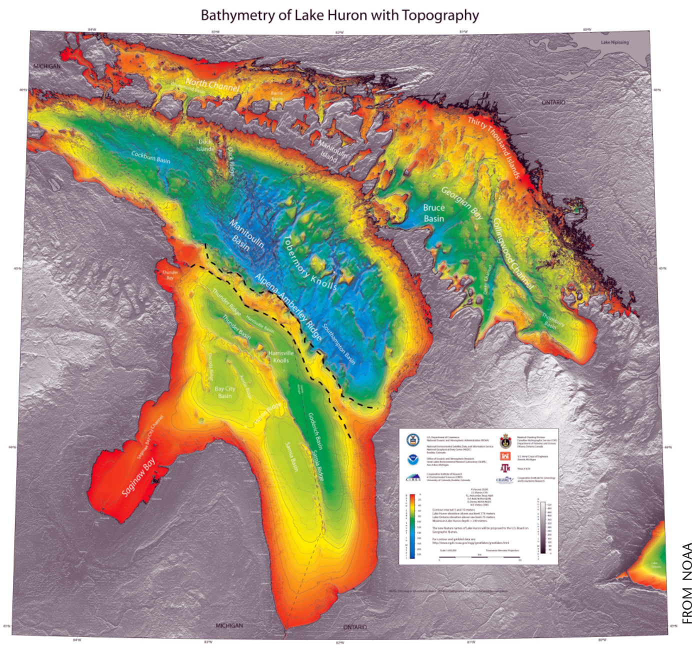
For decades, archaeologists and geologists have studied the evidence for lake levels higher than today's by examining, for example, beach ridges marking the locations of lake margins sometimes far inland from the current lake margins. Until now, however, little has been known about those periods marked by lake levels lower than they are today for the simple reason that they are hidden beneath the cold and relatively deep waters of the lakes.

Now archaeologist John O'Shea, with the University of Michigan Museum of Anthropology, and Guy Meadows from the University of Michigan Marine Hydrodynamics Laboratories, are applying advances in underwater exploration to the investigation of the ancient landscapes beneath the Great Lakes. And they are making some remarkable discoveries, which they reported in the 23 June issue of the *Proceedings of the National Academy of Sciences*.



Remote-operated archaeologists

O'Shea and Meadows are following a "multilayered search strategy" that begins with surface-towed side-scanning sonar mapping of the lake bottom to identify targets of interest. Once they discover an interesting feature in the sonar imagery, they deploy remote-operated vehicles, or ROVs, to examine it more closely. So far they have surveyed a total area of 72 square km of the bottom of Lake Huron at depths of 12–150 m below the modern surface of the lake.



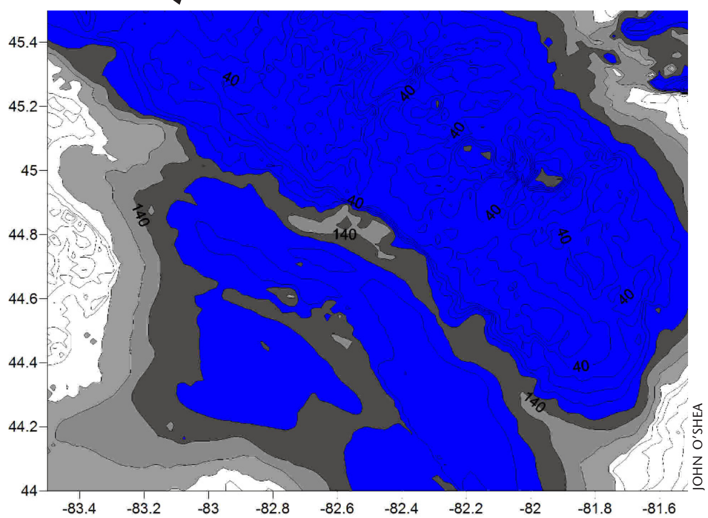
◀ Modern Lake Huron. During the Lake Stanley phase the Alpena-Amberley ridge (dashed lines) was exposed and traversed by game and hunters.

They are focusing on the "most extreme of the low-water stands" in Lake Huron's history. When geologists identify the outlines of an ancient lake beyond or beneath the current shoreline of a modern lake, they usually give it a new name to distinguish it from the existing lake. Hence the shallowest of Lake Huron's previous incarnations is known as Lake Stanley.

A thoroughfare for caribou

During Lake Stanley times, much of the water drained out of the Lake Huron basin to the northeast through North Bay, Ontario. At the time, North Bay had a lower elevation because of the immense weight of glacial ice still pressing down on much of eastern Canada. As the ice continued to melt and recede, the landscape gradually rebounded until the North Bay outlet rose higher than the surface of the lake, thereby allowing the broader Lake Huron basin to refill with water.

Lake Stanley occupied the Huron basin between 9900 and 7500 CALYBP. During this period the lake levels varied between 121 and 96 m below the surface of modern Lake Huron, with the lowest levels occurring during the earliest centuries of its existence. Whenever the depth dropped to below 86 m below the current lake level, the waters of Lake Stanley were divided by a narrow ridge or causeway. This land bridge, called the Alpena-Amberley ridge, which extended from northeastern Michigan near Presque Isle to central Ontario in the vicinity of Point Clark, would have funneled the movements of caribou and their predators—including Paleoindian hunters—between these two otherwise isolated regions.



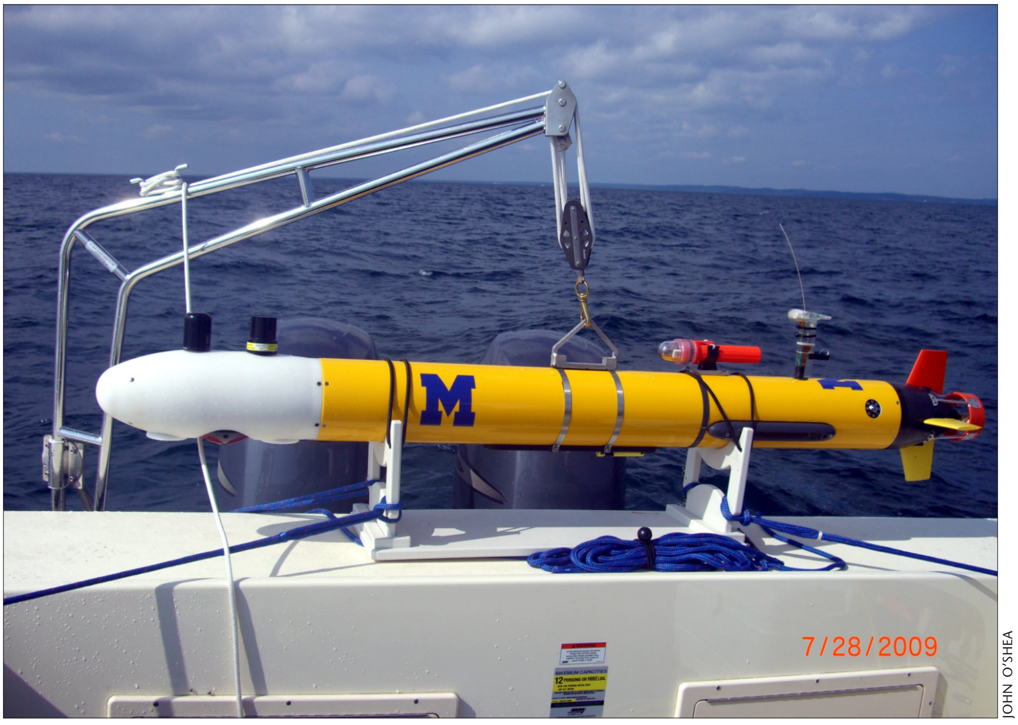
▲ **The central Lake Huron basin during the Lake Stanley phase. The numbers "40" and "140" are elevation in meters above mean sea level (m a.s.l.); areas in white are currently above water. The mean water level in the Great Lakes today is 176 m a.s.l.**

Based on the results they have achieved so far, O'Shea and Meadows conclude that the "combination of sonar and ROV worked well to highlight ancient landforms, locate major rock outcrops with the potential of yielding chert exposures, and identify potential hunting structures."

The archaeology of the Alpena-Amberley ridge

When O'Shea and Meadows began their exploration of the Alpena-Amberley ridge, they found it strewn with boulder fields interspersed with massive exposures of intact limestone bedrock, with thin layers of what O'Shea and Meadows interpret as chert. Such chert outcrops would have been highly valued by the late-Paleoindian and early-Archaic peoples that inhabited this landscape. Unfortunately, images of the lake bottom show that most of the bedrock surfaces are covered with invasive mussel species and algae, which in most instances completely obscure the rock surfaces.

Amidst the obviously natural features visible in the sonar data, O'Shea and Meadows also discerned a few features highly reminiscent of structures used by caribou hunters of the North American arctic and subarctic regions. For example, they identified a serpentine array of boulders 350 m long that they offer as "a strong candidate" for a caribou-channeling structure. Like ethnographically known drive lines, it appears to have been constructed by taking advantage of the natural topography and using small boulders "both to fill gaps and to exaggerate the visual appearance of the feature." Moreover, at either end of the line of boulders is a series of large stones or cairns that would have guided animals into the lane. Finally, at the eastern end of the line is a semicircular area that may be the remains of a constructed hunting pit or blind.



An autonomous underwater vehicle (AUV), this one operated by Dr. Ryan Eustice of the Department of Naval Architecture and Marine Engineering at University of Michigan.

JOHN O'SHEA

Alongside what appears to be an ancient water course, O'Shea and Meadows found two strong sonar reflectors, either two large boulders or two clusters of rocks that are "out of place geologically, and in the correct position for hunting features." Another unusual acoustic target located near this channel is a feature that bears a strong resemblance to "low-walled dwellings or tent rings." Supporting such an interpretation is its location, set back more than 200 m from the banks of the channel in a spot where neither its sight nor scent would alert a migrating herd.

Aerial view of a classic V-shaped funnel of drive lanes with semi-circular shooting pits at the narrow end. Victoria Island, Nunavut, Canada.

JACK BRINK

The results of O'Shea and Meadows's preliminary survey of the Alpena-Amberley ridge "confirm the existence of conditions necessary for the discovery of archaeological sites" in this strategic geographical setting and demonstrate features consistent in form, construction, and placement with known caribou hunting structures. They acknowledge that these results must be regarded as tentative until they are able to provide ground-truth of these provocative targets by scuba-diving archaeologists searching for direct evidence of human modification. The divers' mission will be enormously complicated by great masses of mussels and algae that cover much of the bedrock and "prevent remote observation of the rock surface or of smaller debris along the outcrops."

O'Shea and Meadows caution, however, that even if archaeologists are able to survey these sites firsthand it may not be possible to identify the features with absolute confidence as man-made structures. Archaeologists working at analogous structures in the Canadian arctic typically find very few artifacts associated with them. Moreover, Inuit hunters utilize natural features of the landscape and alter them in ways that archaeologists find difficult to recognize even a few decades later. For example, in his account of Nunamiut Eskimo caribou drive lines, ethno-archaeologist Lewis Binford describes simple stone piles that hunters festoon with moss and old clothes to mimic a man “to scare the caribou, keep them moving, and restrict their movement to the path chosen by the hunters.” Binford cautions that such features, which he calls “soldier rocks,” would be “very difficult to detect without ethnographic information.”

O’Shea and Meadows are nevertheless confident that such evidence will be recoverable when they undertake direct dive operations in the next stage of investigation. Quarry and workshop sites associated with the chert outcrops will be recognizable by large quantities of lithic debris, ranging from broken and unfinished stone tools to rough blocks of partially worked chert and waste flakes. Habitation sites may be identified by remains of structures such as tent rings, as well as various stone artifacts. And finding an underwater habitation site promises extra rewards for archaeologists: Bones and artifacts made from organic materials that don’t survive at most terrestrial sites are wonderfully preserved when submersed in freshwater.

BOTH: JACK BRINK

▲ A single cairn on Victoria Island, Nunavut, Canada. Left unmolested, individual cairns can remain standing for hundreds, possibly thousands of years.

◀ Individual cairns can be single rocks tipped on end, or small clusters of stacked rocks like these on Victoria Island, Nunavut, Canada.

New developments

Since the publication of the preliminary results in the *Proceedings of the National Academy of Sciences* in June, O’Shea and Meadows have continued their research. O’Shea informs us that although their opportunities to conduct diving operations on the Alpena-Amberley ridge so far have been limited, already this autumn they have “confirmed the presence of extensive chert layers” in the limestone bedrock. These chert outcrops and the search for potential quarry sites will be a major focus of their work next spring.

They have also begun experimenting with a small autonomous underwater vehicle (AUV) to obtain close-up acoustic and photographic images of interesting bottom areas. After running the AUV over an area where previous surveys detected possible evidence of a campsite, the AUV discovered a promising feature, a series of similarly sized rings of stone. O’Shea confirms that the team is now processing several thousand individual photographic images taken concurrently with

continued on page 20

Paleo Woman

continued from page 3

At the time the coterie of scientists that would eventually burgeon and monopolize Clovis archaeology included few if any female archaeologists. For Adovasio, it’s only natural that “mostly male archaeologists found almost entirely stone tools and weapons and assumed that it was a man’s world back in the Pleistocene and earlier.” Researchers, after all, quite naturally gravitate to what fascinates them. Chilton, after analyzing data collected by the Society of American Archaeology, finds that “a higher percentage of men are interested in lithics as an analytical tool, while a higher percentage of women are interested in ceramics.” She also notes that men are more likely to study Paleolithic or Neolithic periods; women prefer “state societies, and historic and proto-historic time periods.” There’s nothing sinister in her conclusions. We should, however, be aware that such biases can blur our perceptions of the past.

It's a truism but worth stating anyway that today's archaeologists are a product of the 21st-century environment but the ancient people they study weren't. This is a caveat most archaeologists are conscious of today and, Adovasio concedes, that "they try to take into account." Nonetheless, being aware of the danger that our own cultural predisposition tends to introduce prejudgments and personal prejudices when interpreting the past is a lesson it took archaeologists a long time to learn. At the time of earlier periods of study they had achieved only partial success. This goes a long way toward explaining why early Americans were viewed through the lens of 1950s America. Male and female roles were obvious and undisputed: Clovis Man headed out every morning to bring home the bacon, Clovis Woman stayed home to cook and mind the children. The cultural norms prevailing when early Americans were first discovered and in the decades that followed thus resulted in gender bias that skewed the direction of research and colored conclusions drawn from the data. Adovasio, forgiving of his male colleagues, allows that "it was more an unconscious bias than a deliberate and nasty plot against women."

Adovasio allows that although the ratio of male-to-female Ice Age scholars has changed sharply in the past 15 years, "the tyranny of preservation has continued to result in an emphasis (or overemphasis) on the almost always preserved lithic suite." Few archaeologists, even in the past when females were under-represented, have appreciated the story that perishable artifacts tell about Paleoindians and European Ice Age populations. Despite dozens of publications in the recent past stressing the role of perishables and their presumed principal artisans, women, "this is not a point that has resonated through the ranks of Paleoindian or late-Pleistocene scholars."

In conclusion: More questions

"All of our reconstructions," Adovasio says, "of Paleo-Indian socioeconomic behavior up to the very recent past have pivoted around the role of mature males to the near total exclusion of females, children of either sex, or the old. Consequently, we have essentially excluded almost all of the equally productive members of Paleo-Indian society to concentrate instead on the male component."

We've seen how visualizing Paleoamericans as explorers, overemphasizing hunting and stone tools, and a dearth of female archaeologists have conspired to demean the role of Paleo Woman and nearly banish her from prehistory. The next question is, How can we use this information to seek Paleo Woman as she truly was? We'll offer some answers in part II of this story next issue.

–K. Hill

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Suggested Readings

Adovasio, J. M., O. Soffer and J. Page 2007 *The Invisible Sex: Uncovering the True Roles of Women in Prehistory.* Left Coast Press, Inc. Walnut Creek, Calif.

Barton, C. M., G. A. Clark, D. Yesner, and G. Pearson (eds.) 2004 *The Settlement of the American Continents: A Multi-disciplinary Approach to Human Biogeography*, pp. 162–72. University of Arizona Press.

Chilton, E. S. 2008 "Queer Archaeology, Mathematical Modeling, and the Peopling of the Americas." Paper presented at the Annual Meeting of the Northeastern Anthropological Association, Amherst, MA. Available at: http://works.bepress.com/chilton_elizabeth/3/

——— 1994 In Search of Paleo-Women: Gender Implications of Archaeological Remains from Paleoindian Sites in the Northeast. *Massachusetts Archaeological Society Bulletin* 55(1): 8–14.

decoding the woolly mammoth part II

DEBI POINAR

Close-up view of mammoth tusks stored at Xatanga, Siberia.

A Closer Look at the Genetic Evidence

When humans first set foot in Pleistocene North America, they encountered vast numbers of caribou, bison, horse, elk, musk ox, and the other large mammal species now collectively known as megafauna. The hands-down winners in this category were the native elephantids, the large shaggy mastodons and their cousins the mammoths, exemplified by the woolly mammoth (*Mammuthus primigenius*). Today mammoths are considered *the* iconic Pleistocene animal, not just among scientists and interested laymen but in popular literature and film as well. “There’s a fascination there among all age groups,” notes Hendrik Poinar, who directs the Ancient DNA Centre at McMaster University in Ontario. “Woolly mammoths were a pan-Arctic species living on both sides of the pond, and I think it’s the combination of their size, extinction, and extent that makes them so fascinating.”

In the first part of this series we introduced the woolly mammoth itself and outlined what recent genetic testing has revealed about the species (**MT 24-4**, “Decoding the Woolly Mammoth, Part I”). In this installment, we’ll take a closer look at what this fascinating creature has to tell us at the genetic level: how the species spread and thrived during the last Ice Age, and how it was related to other, similar species—some now extinct, some not.

The studies

“There’s no question: Among extinct mammals, mammoths are definitely Number One in terms of what we know about their genetics,” declares Ross MacPhee of the American Museum of Natural History. In large part, this is due to the sheer ubiquity of their remains. Scientists are forced to reconstruct most extinct creatures from a few bone fragments, with the occasional hair or scale thrown in for flavor. Not so, fortunately for us, with the woolly mammoth. Because it preferred to live in subarctic environments, not only do we have thousands of tusks and bones to study, in some cases soft tissues have been preserved intact for over 10,000 years. This has provided the exciting opportunity to examine the woolly mammoth right down to the subcellular level; in recent years, we’ve even gotten a good handle on their DNA.

The earliest mammoth DNA studies focused on mitochondrial DNA (mtDNA). As the name implies, mtDNA exists only in the cell’s mitochondria—tiny structures that power individual

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cells. For complicated reasons, mtDNA is passed only from mother to child. Not only does it not recombine like nuclear DNA, it's more likely to mutate over time. Consequently it's often used to track back and determine relationships among particular lineages and even species. In 2006, three research groups published their findings in the prestigious journals *Science, Nature*, and *PLoS Biology*. The group reporting in *Science* examined a 12,000-year-old mammoth specimen; the *Nature* group probed both the mitochondrial and nuclear DNA of a 28,000-year-old specimen; and the *PLoS Biology* group sequenced the entire mtDNA genome of a specimen approximately 33,000 years old.

Based on these studies, it was estimated that the lineage of African elephants (*Loxodon*) diverged from the line that led to mammoths (*Mammuthus*) and Asian elephants (*Elephas*) somewhere in Africa 6 mya (6 million years ago); Asian elephants and mammoth went their separate ways 440,000 years later. Those numbers were later adjusted to 7.6 and 6.7 mya respectively in an extensive nuclear-DNA study published in the 20 November 2008 of *Nature*. In either case, this divergence was amazingly swift on a biological timescale. It turns out that mastodons, the other elephantids of Pleistocene North America, diverged from the line leading to mammoths at least 24 mya (see sidebar).

Interestingly enough, the evolutionary flurry that led to both elephants and mammoths occurred at about the same time our own hominid line was diverging from that of its near relatives, the great apes. It's possible that the same environmental factors played a part in both events, though that's hard to say; what's obvious is that the elephantids evolved about half as fast as the hominids did during this period. This doesn't surprise Dr. Poinar. "Evolution is faster in warm environments than in cold ones," he explains. "And evolution in elephants is really slow. Evolution seems to be linked with the size of animals; in bigger animals the metabolism is slower, so mutation rates are slower. It also appears that there were lots of hominid species/progenitors walking around in Africa, which leads to lots of crossbreeding and recombination, which leads to much faster evolution."

Poinar collecting a sample from a mammoth bone at the Zoological Institute in St. Petersburg, Russia.

DEBI POINAR

In addition to refining our understanding of the genetic relationships among the elephantids, DNA studies like these may eventually yield additional details concerning the form and appearance of mammoths, common diseases associated with the genus, and which genes might have been part of the "cold package" that allowed mammoths to adapt so well to chilly climes. But all this lies in the future, awaiting the development of better technology for interpreting the data derived from ancient DNA samples.

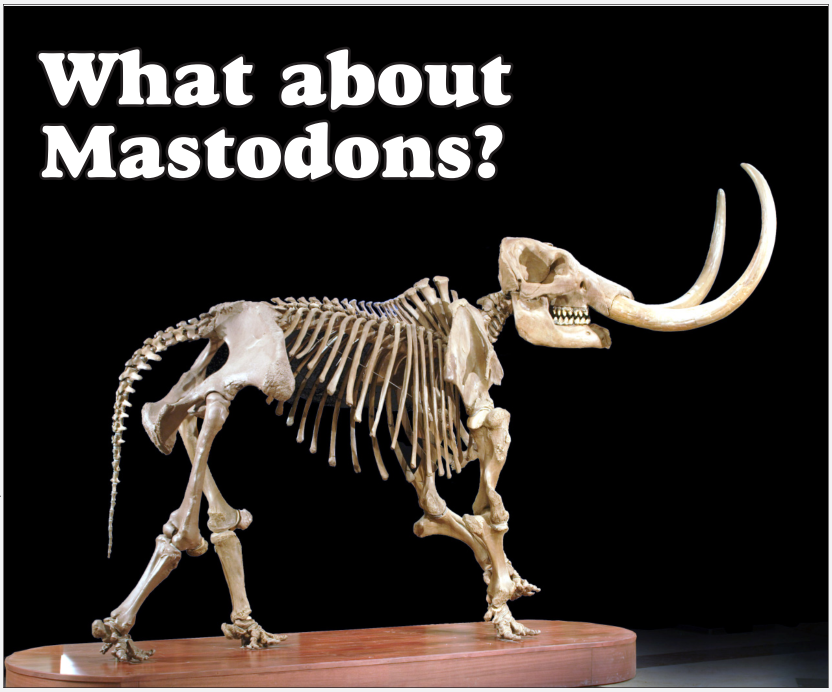
Here's the deal: We've reached a technological impasse. Most fossil DNA samples provide almost too much data because they're contaminated with everything from soil fungus to modern human DNA. Therefore it's critical to screen out contaminating taxa and isolate what you're after. The less detail you have, the more you're likely to produce erroneous results. Sifting and selecting to an increasingly fine level, however, requires increasingly powerful computers. "There's no way a human mind can deal with data masses of that magnitude, so it has to be packed down and interpreted by machine," Dr. MacPhee points out. "The more data you get, the more careful you have to be."

Back across the Land Bridge

Now, that's not to say that we can't tease some very interesting information out of the data with the technology we already have. Here's an excellent example. Though an early study suggested that the woolly mammoth genome had very little genetic diversity by the end, a more recent study has proved quite the opposite. In the 9 September 2008 issue of *Current Biology*, a large research group that included both MacPhee and Poinar published the findings of an analysis of 160 woolly mammoth DNA samples from the Old World and the New. Among other conclusions, the results demonstrate quite clearly that not only were terminal-Pleistocene mammoth populations *not* genetically impoverished, they were dominated by American strains. "What we see," says Poinar, "is that the American haplotypes that originated in Yukon did quite well, migrated to Siberia and pushed out the guys already there." Why and how this happened remains unclear. As MacPhee puts it, "We're not at the point where we can talk sensibly about populations of mammoths, any more than any other extinct species. That's the grail we're after, but we're not there yet."

Lacking a handy time machine, we're obliged to extrapolate from existing animals, which can be a tad dangerous. But it's easy to understand how American mammoths may have expanded at the expense of their Asian brethren. It's well established that high-latitude mammals experience significant population fluctuations based on various factors, particularly

What about Mastodons?



MUSEUM OF PALEONTOLOGY, UNIVERSITY OF MICHIGAN

Large and impressive as they were, mammoths weren't the only proboscideans endemic to Pleistocene North America. They shared most of the continent with a distant relative, a shaggy tusker called the mastodon. This unusual name, which means "nipple-tooth" in Greek, refers to the distinctive protrusions on the crowns of the mastodon's molars, which tip the scales at about five pounds each.

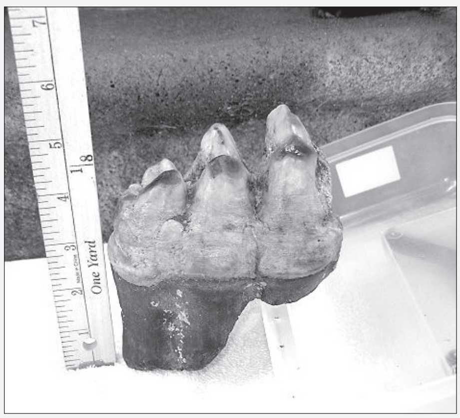
Mastodons were by far the elder lineage, having originated in central Africa approximately 40 mya. By 24 mya, their line had split from the evolutionary branch that eventually resulted in the mammoths and elephants. The final species in the lineage, the American mastodon (*Mammut americanum*), could trace its roots back to about 3.7 mya.

In general, mastodons were shorter and more powerfully built than mammoths, with pillar-like legs and long red-brown hair. They've been referred to by some observers as "Neanderthal" versions of elephants, given their more primitive dentition and stocky build. Though they were hairy like our friends the woolly mammoths, mastodon hair was similar to that of their distant oceangoing cousins, the dugongs and manatees; mammoth hair, on the other hand, was very like that of living elephants. Like the mammoth, the mastodon had a pronounced hump and small ears compared with those of modern elephants. The skull was lower and flatter too, but the tusks put both *Loxodon* and *Elephas* to shame: Stretching 8–10 ft long at adulthood, they curved slightly upward, though not as extravagantly as a mammoth's.

The teeth tell the main story, however. Their odd features make it clear that mastodons were browsers—that is, that they fed primarily on leaves, fruit, and other products of trees, vines, and large shrubs. Deeply rooted, large, and low-crowned, mastodon teeth display up to eight cusps separated by deep troughs. Although some observers consider them less complex than teeth of mammoths or modern elephants, they appear to be ideally suited for their primary task of stripping branches of leaves, needles, and fruit. Mammoths, on the other hand, were grazers, subsisting almost exclusively on grasses, sedges, rushes, and small shrubs. And although it's hard to determine animal behavior from fossils, mastodons apparently didn't browse in herds as mammoths did, preferring instead to range alone over large areas. This strict differentiation in eating habits is what allowed the two elephantid varieties to coexist in the same regions. Like all mammoth species except the woolly, the mastodon was distributed through most of North America, from the Arctic in the north to Honduras in the south, and from New England to California on an east-west axis.

The last mastodons died out at the end of the Pleistocene for reasons that still elude us. As with most megafauna, causes ranging from overkill to disease have been postulated, but the complete truth may never be known. Unlike woolly mammoths, which we know survived in isolated refugia until as recently as 4000 CALYBP, the evidence suggests that the end came comparatively abruptly for the mastodons.

–Floyd Largent



MILDRED MCFARLAND

Mastodon tooth found on the Gulf shore in southeast Texas. See MT 24-2, "Page-Ladson Gets INTIMATE," for more details about this interesting find.

the weather. Combine wide birth spacing with a bad winter in which few calves survive, and a mammoth population could easily suffer a severe and sudden decline. More fortunate populations could then expand into their territory and either outcompete or subsume them. In the late Pleistocene, the winners of the mammoth genetic lottery were American—but this was pure happenstance. Western Beringia just happened to be a harsher environment to live in during the last Ice Age, so once conditions improved after one particularly bad period, eastern mammoths were able to migrate west and displace Siberian populations.

Back from the dead?

Considering the abundance of preserved woolly mammoth cells to work with, the idea has been floated about that we

continued on page 20

MAMMOTH TRUMPET
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Early Human Occupation *in the* NW Plains of Uruguay

by Rafael Suárez

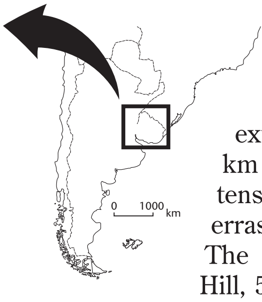
THE ARCHAEOLOGY of the late Pleistocene in southeast South America hasn't attracted as many investigators as other regions of the continent, for example, Pampa and Patagonia, and consequently isn't as well known. Our relatively meager knowledge of this region, especially of Uruguay, can't be blamed on a paucity of early occupations. Instead, the fault lies with flawed investigation strategies that aren't designed to look for early stratified archaeological sites.

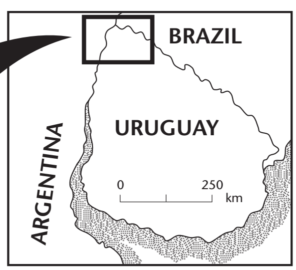
In 2000 our research team undertook a long-term investigation of early human occupations in the Uruguay plains during the late Pleistocene and early Holocene. The team includes geologist Gustavo Piñeiro and paleontologist Andrés Rinderchneckt (both University of Sciences, Uruguay), Mario Trindade (Museo de Arqueología of Salto), and various avocational and amateur archaeologists from the cities of Bella Unión and Paso de los Toros. Recently two North American scientists contributed their talents, Dr. Chris Gillam (University of South Carolina) to develop a GIS database of early human occupations in Uruguay, Dr. David Leigh (University of Georgia) to initiate geoarchaeological studies on early sites in dunes in central Uruguay. Our project is indebted to Dr. Laura Miotti (University of La Plata, Argentina) and Dr. Bruce Bradley (Exeter University, UK), whose expert advice often smooths rough patches of road we encounter in our investigation.

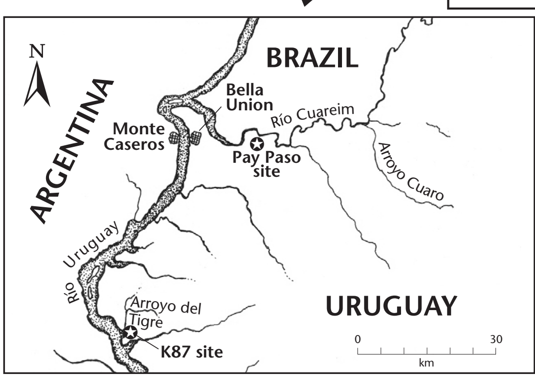
Discoveries waiting to be found

The archaeology of the first Americans in Uruguay is exciting because its depths haven't yet been plumbed. The investigative potential is so vast that our first order of business was to determine where and how to search for early occupations. The principal goal we've adopted, an ambitious one to be sure, is to generate a cultural, chronological, stratigraphic, and paleoambiental database for the archaeology in the terminal Pleistocene. Subtext to our stated purpose of mission concerns Fishtail points, those exquisite projectile points that are as emblematic of the earliest South American culture as fluted points are of the North American; we plan to describe every aspect of their lithic technology and morphological and functional variability.

A final and not insignificant secondary goal of our research is to search for human occupations that predate 13,500 CALYBP—in short, that reveal pre-Fishtail occupations in Uruguay. Recently we began investigating a complex of caves and rockshelters Trindade found in Cuchilla de Haedo with evidence of early human occupation. So early, in fact, they hold the exciting potential of revealing pre-Fishtail occupations in Uruguay.







Uruguay had much to attract hunter-gatherers by 13,000 CALYBP. Its expanse (it extends 550 km north-south, 480 km east-west) encompasses extensive plains, rolling hills, and sierras. It's gentle, low-lying terrain: The highest elevation is Catedral Hill, 513 m a.s.l. Río Negro divides the country neatly into east and west regions, and there are extensive additional rivers and arroyos. Distributed across the landscape are primary outcrops of silicified sandstone and limestone, translucent agate, chalcedony, opal, jasper, silicified wood, quartzite, rhyolite, and varieties of chert, which became quarries of plentiful raw material for toolmakers throughout prehistory. Abundant fresh water and lush grasslands attracted masses of herbivores and, in turn, the early human hunters that preyed on them.

The Pay Paso site, a diamond in the rough

This site (30°16′ S, 57°27′ W) lies in the plains of Río Cuareim, a tributary of Río Uruguay, which forms the Uruguay-Brazil-Argentina border. It was investigated in 1979–89 by A. Austral, who obtained an age of 9890 RCYBP. Subsequent reinvestigations of the site begun in 1999 have made Pay Paso the most intensively excavated Paleoamerican site in Uruguay. This site is the keystone of regional archaeological research, for it is yielding valuable insights into the earliest human occupations in the north of Uruguay during the Pleistocene/Holocene transition.

The Pay Paso site has nine localities of paleontological, paleoenvironmental, paleovegetational, and archaeological interest, with similar stratigraphical and sedimentological features resulting from complex geomorphologic processes.

Locality 1 is a Paleoamerican multicomponent campsite, with three early human occupations. Over four field seasons we dug 8 m^2 of survey pits and excavated blocks of 90 m^2 and 15m^2. (The old lower archaeological level is at a depth of 5.70–5.90 m.) We found cultural remains in a white-grey-yellow deposit formed by fluvial (sand and clay) and aeolian (loess and volcanic ash) sedimentation. Three cultural levels are separated by sterile layers of clays. Four AMS radiocarbon dates from the earliest, Level 1, range from 10,930 to 10,880 RCYBP. *This means that the earliest occupation found to date at Pay Paso rivals the earliest Clovis occupation found in North America* (the Lange-Ferguson site in South Dakota, 11,080 ± 40 RCYBP). Cultural Level 2 dates to 10,205–10,100 RCYBP; the most recent level, Level 3 (where we found the Pay Paso points discussed below), dates to 9585–9100 RCYBP. Radiocarbon dates obtained on 32 samples from the three levels translate to calibrated ages of 13,000–9550 CALYBP.

Diagnostic tools recovered from excavations include a new projectile-point type, the Pay Paso point, preforms, bifaces and blade tools, standardized sidescrapers, choppers, and cores. Besides a diagnostic fluted Fishtail point, we recovered from Pay Paso 1 site an unusual ultrathin oval biface. Stone used to make tools at the Pay Paso site was principally silicified sandstone (84.5%), translucent agate and chalcedony (13%), and jasper-opal (1%); other materials rarely used (1.5%) include silicified limestone, quartz, basalt, and unknown stone. Toolmakers at Pay Paso prized high-quality stone: The source for the agate they used lies 140–170 km distant.

The Pay Paso 1 site is the only archaeological excavation in Uruguay that has yielded late-Pleistocene animal remains, the bones of 186 individual specimens. Bones of prehistoric horse (*Equus*), giant armadillo (*Glyptodon*), otter, and boga fish (*Leporinus*), and fragments of eggs of the giant bird ñandú (*Rhea americana*) were found associated with human artifacts. Although we must be very cautious in interpreting fragmentary data, it appears that early hunter-gatherers in the north of Uruguay may have supplemented their diet of large game (horse and armadillo) by taking small mammals (otter) and fish (boga) and gathering eggs. The data, though partial, are good enough to form a provisional hypothesis, that human occupants at the Pay Paso 1 site practiced generalized exploiting of resources and did not depend exclusively on Pleistocene mammals for sustenance, as appears to be the case in early archaeological contexts in Pampa and Patagonia. Further investigations are needed to confirm or refute this theory.

ALL PHOTOS: RAFAEL SUÁREZ

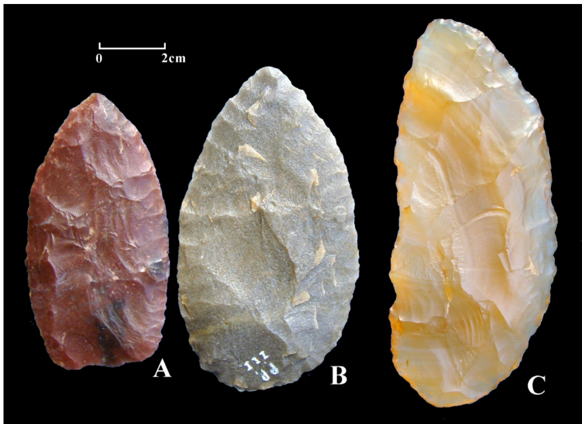
An ultrathin biface and other artifacts in situ in the Pay Paso 1 site excavation.

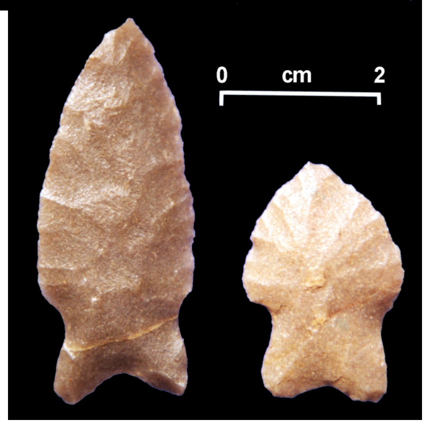
A new type of early-Holocene projectile point

In Level 3 of Pay Paso 1 we found a new type of projectile point that we call the Pay Paso point. Specimens were found in contexts dated (by eight calibrated AMS dates) at 10,930–10,250 CALYBP. The Pay Paso point is a shouldered triangular blade; the well-defined stem with concave edges expands in ears toward the base, which is markedly concave. After Pay Paso points were also found at the K87 site about 45 km from Pay Paso site, where they date to around 10,000 RCYBP, I scoured private archaeological collections for other instances of this new point type. To date I have recorded 21 Pay Paso points recovered from regions of Uruguay as remote as the Negro and Tacuermbó rivers, approximately 300 km from Pay Paso. These findings give us a good idea of the impressive mobility of Pay Paso hunter-gatherers and the enormous territory they traversed.

The Pay Paso 1 site excavation during fieldwork in 2006.

Like Fishtail points, Pay Paso points display evidence of extensive resharpening, which tells us these artifacts enjoyed a long use life. Pay Paso points are an example of technological adaptation in post-Fishtail times resulting from the human reorganization that occurred in the early Holocene in southeast South America. The evidence from our excavations at Pay Paso, however, tells us the Fishtail culture and the Pay Paso culture aren't contiguous in time. There appears to be a hiatus in the chronological record, a gap marking the absence of an unknown number of successive human groups that invented unique designs of projectile points. Those missing generations of toolmakers and their products are waiting to be found.





Bifaces from the Pay Paso site. A, biface of ▲ silicified limestone from the Queguay Formation, basally thinned on both sides; B, oval biface of very fine grain silicified sandstone; C, asymmetrical biface, possibly a bifacial knife, of translucent agate from the Catalan arroyos quarries, Arapey Formation (from R. Moreira collection, Bella Unión).

Pay Paso points from cultural Level 3 of the ▶ Pay Paso type-site (ca. 9585–9100 RCYBP). Note the highly resharpened blade on the point on the right. Both are made of very fine silicified sandstone of the Arapey Formation.

Fishtail technology in Uruguay

Fishtail points in South America generally, and in Uruguay particularly, show an important albeit puzzling variability in design, stage sequences in manufacture, morphology, and function. For example, in Uruguayan Fishtail points the base of the stem can be straight, slightly concave, or exaggeratedly concave. In North American paleotechnology, the differences in the base profile among Clovis and Gainey-Vail-Debert points have been attributed to post-Clovis adaptations, owing to the younger ages obtained for Debert-Vail points (about 10,500 RCYBP, compared with Clovis at 11,050–10,800 RCYBP). The picture isn't so clear for Uruguayan Fishtail points. We don't know whether the differences in the bases of Fishtail points are the result of chronological sequence (one specimen being older than the others), or whether Fishtail points differ because they're made by different peoples, or whether they differ according to specific hafting techniques, expressions of cultural significance, individual knapper preferences, or any of a number of other possibilities.

Roberto Moreira and Gustavo Piñeiro conducting an archaeological survey in the Arroyo Catalán Chico quarries and workshop site. In the background is Taddei Hill.

My belief that archaeologists dedicated to the study of South American lithic technology should be more critical in the study of Fishtail points motivated my studies on variability in the design and techno-morphological details within the Fishtail-point assemblage. From my initial observations in 2003 of variations in blade size, I proposed an idealized model for rejuvenation of Fishtail points of the Southern Cone (see "Paleoindian Components of Northern Uruguay" in "Suggested Readings"). Specialists in lithic technology hadn't considered the angle of the shoulder-stem junction a significant morphological detail; it seemed to me an extremely significant trait and worthy of defining two morphological variants. One is the pronounced or prominent shoulder, with a shoulder-stem angle of about 90°–110°; the other is the "classic" Fishtail design, with insinuated or rounded shoulders and a shoulder-stem angle of about 120°–160°.

Fluting is another distinguishing characteristic. Not all Fishtail points are fluted. In a sample of 90 Fishtail points from Uruguay, 62.5% exhibit stem base thinning by regular or laminar retouch, 37.5% are fluted on one side of the base stem, and only 12.5% are fluted on both sides of the base stem.

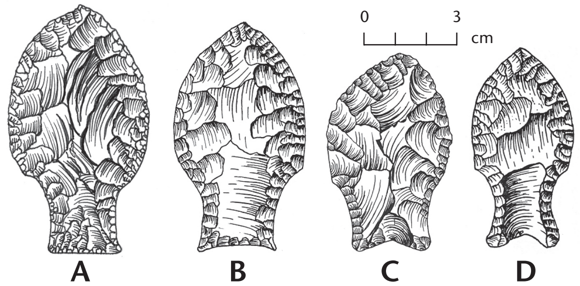
Fishtail and Clovis: Is there a link?

Some North and South American Paleoamerican researchers in past decades, and even some today, have suggested the existence of either a direct link or an ancestor-descendant relationship between the Clovis and Fishtail cultures. No one to my knowledge has offered compelling proof of this theory.

Perhaps the well-known late-Pleistocene technologies of Clovis and Fishtail peoples (about 13,100–12,500 CALYBP) are expressions of a new technology that entered the Americas around 15,000–14,000 CALYBP, which was seized on and modified by preexisting cultures in both continents. (See "The Late Pleistocene Dispersal of Modern Humans in the Americas" and "AMS ^{14}C Dating Early Human Occupation of Southern South America" in "Suggested Readings.")

By their toolstone shall you know them

Quarries are valuable for archaeologists because they figure so centrally in the technological organization and mobility of hunter-gatherers. Our research team is making a detailed study of quarries and workshops associated with agates and highly silicified sandstones found in the Arapey Formation in north Uruguay. The Arroyo Catalanes district is known today for the commercially significant volume of agates and amethysts exported from Uruguay to China. In the course of performing Cultural Resource Management studies I found 10 prehistoric quarries and workshops of agate in the Arroyos Catalanes. Moreover, there is evidence of the use of translucent agate by toolmakers to produce projectile points, bifaces, blades, and other artifacts in sites K87 (about 12,300 CALYBP) and Pay Paso 1 (about 12,800–9550 CALYBP). Early hunter-gatherers traveled distances of more than 150 km from their home sites on the Uruguay and Cuareim river plains to the agate quarries and outcrops found in the area of the Arroyos Catalanes. Individuals and groups of humans traveled great distances during the late Pleistocene and early Holocene solely to quarry agate for making artifacts.

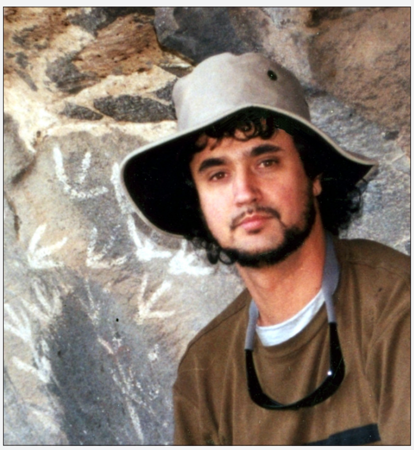


▲ Variants of the stem-base observed in Fishtail points of Uruguay. A, straight; B, slightly concave; C, concave variant with inverted "V"; D, concave pronounced.

◀ Fishtail points from the middle Río Negro basin. A, from the Arroyo Tres Árboles site; B, from the Arroyo Cacique site (note the highly resharpened blade). Both are made of silicified limestone, a particular chert of the Queguay formation much utilized by Fishtail-point knappers. (S. Bálsamo collection, Paso de los Toros, Tacuarembó).

We have barely begun to understand these ancient people.

About the author Rafael Suárez is a researcher of the Museo Nacional de Historia Natural y Antropología (National Natural History and Anthropology Museum) under the joint auspices of the National System of Investigators (SNI-ANII) and the Agency of Investigation and Innovation of Uruguay. His principal interest is the peopling of southeast South America, especially regarding lithic technology, Fishtail-point variability, and early hunter-gatherer adaptations. Last July he presented his Ph.D. dissertation in the Facultad de Ciencias Naturales y Museo (University of La Plata–Argentina). Dr. Suárez is director of two archaeological research projects in northern and central Uruguay, with special focus on human adaptations and paleoenvironmental reconstruction in the late Pleistocene and early Holocene. He was principal investigator of research grants from the National Geographic Society (U.S.), the Wenner Gren Foundation (U.S.), and the National Science Foundation (Uruguay).



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Suggested Readings

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Suárez, R. 2003 Paleoindian Components of Northern Uruguay: New data for Early Human Occupations of the Late Pleistocene and Early Holocene. In *Where the South Winds Blow: Ancient Evidences From Paleo South Americans,* editors L Miotti, M. Salemme, and N. Flegenheimer, pp. 29–36. Center for the Study of the First Americans.

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Use Wear, Up Close

CHARLOTTE PEVNY & ASHLEY SMALLWOOD

Charlotte Pevny and Ashley Smallwood butchering with stone tools.

SHOW SHERLOCK HOLMES the murder weapon, and he'll show you the killer. Maybe Holmes could instantly deduce volumes from a single glance at an object, but in the real world, the one scientists inhabit, truth is almost always much more complex and doesn't come so easily. Because time is unkind to organic remains, archaeologists rely heavily on interpreting minute clues found on the stone tools Paleoamericans used. That's the function of use-wear analysis, an investigative discipline that was born in the last century and flowered in the 1970s. Expert use-wear analysts—you'll meet several in this article—can frequently deduce how a stone tool was held or hafted, the kind of material worked, the scraping or sawing or drilling motion used by the worker, all from microscopic clues on the tool. Holmes with his magnifying glass would be impressed.

The nitty gritty of making sense of tool wear

In the late 1960s Russian archaeologist Sergei Semenov published *Prehistoric Technology.* It proved to be an eye opener for archaeologists worldwide, who since the later half of the 19th century had struggled to deduce how tools no longer in existence were used. For archaeologist Marvin Kay of the University of Arkansas, the photographs in Semenov's book clearly demonstrate "signals of motion that would be created as you used the tool."

Modern use-wear techniques involve both macroscopic and microscopic approaches, "I first evaluate if there is macroscopic wear or flaking along the edge," says Ashley Smallwood, a doctoral candidate in Anthropology at Texas A&M University (**MT 21-4,** "Clovis at Topper"). "If I can identify a working edge, I pull my sample based on that. Then I like to use high-power use-wear analysis mostly, as high as 500 power. You can see the surface, linear indicators, striations, and polish formations clearly at that magnification."

CSFA hasn't scrimped on equipment. A Leica DMLA Compound Microscope with magnifications of 100x, 200x, and 500x works with an impressive software program called Coolsnap Pro. The program takes the lowest and highest points of microtopography that the analyst focuses on, then stacks and combines images to display the topography of the tool with an extended depth of field. Anyone who has ever looked at a 3-dimensional object under a microscope appreciates the immense advantage of an extended depth of field in analyzing the microtopography of stone artifacts.

SVEND HANSEN

Kay talking about use-wear studies to a research group at Pietrele, Romania, August 2008.

When searching for microscopic signs of use wear, analysts look to asperities (roughness or texture) on the surface of the tool as well as striations. Even a surface that appears perfectly smooth to the naked eye has microscopic projections and bumps. When another surface comes into contact with the tool surface, those asperities become worn down and truncated, like mountains flattened to mesas, a process known as polish. Polish is frequently a good indicator of use and can also give clues about the kind of material that was worked.

Striations, another category of microscopic features, are troughs or scratches on the surface. They show Marilyn Shoberg, lab research associate at the Texas Archeological Research Laboratory in Austin, the kinematics or motions involved in using the tool. "If a tool was used in a longitudinal cutting motion, as if you were reaping grass," she explains, "it will have striations parallel to the edge that tell you it was used *along* the edge as opposed to a tool that was used scraping *perpendicular* to the edge." (Striations and polish aren't to be confused with residue, microorganic deposits left on the surface of a well-preserved stone tool.)

BOTH: CHARLOTTE PEVNY

Behind the scenes

Before an artifact ever goes under the microscope, the investigator must gather information on its original archaeological context—soil type, presence of nearby water systems, whether the artifact was buried or a surface find, whether it was isolated or associated with other artifacts. What's more, the analyst must experiment using a replica of the tool to appreciate how the tool was probably used, where to expect to find wear, and the kind of wear to look for. Jim Wiederhold, CSFA microscopist *extraordinaire* (**MT 19-2,** "Use Wear: A Hands-on Study"), has butchered bison and worked hides using authentic replicas of paleo tools. "Common sense dictates that you've got to look at the end product and put yourself in the place of someone trying to create something with a piece of rock," he tells us. "You can't just arbitrarily scrape a piece of hide 500 strokes. You have to make an end product, and whatever use wear comes up in the process—*that* should be the analog."

Smallwood concurs. Before sitting down to analyze 67 bifaces from the Gault site, a Paleoamerican campsite in east-central Texas (**MT 20-1** and **-2,** "Assault on Gault"), she used replicated stone tools the same way a hunter likely did 13,000 years ago, and even butchered carcasses. Experimental programs are important, she says, "because you have to understand what happens to the rock when you use it, and you have to be able to differentiate use wear from all the background noise that happens to the rock once it is deposited."

By background noise she means polish or other use indicators created on an artifact by post-depositional processes and not related to use wear. (In the archaeologist's lexicon, *post-depositional* refers to anything that happens to an artifact once it enters the archaeological record.) At Excavation Area 8 at the Gault site, for example, a variety of post-depositional processes affected use-wear analysis. Water can be the microwear analyst's worst enemy, and the Gault site suffers from a superabundance because of its location at the headwaters of Buttermilk Creek. Seep springs frequently saturated portions of the site; this resulted in high levels of iron and manganese in the soil, causing yellowish discoloration to most of the Paleo artifacts. Calcium carbonate, another waterborne chemical, encrusted approximately 98 percent of the flake assemblage from the site and hindered microscopic examination of those flake surfaces.

Wet/dry cycles, especially at sites with clay soil, can create what scientists call soil sheen, a ubiquitous polish that can be caused by repeated shrinking and swelling of surrounding soil. Charlotte Pevny says soil sheen is easy to differentiate from use wear because it covers the entire artifact and not just the edge, the place where we expect to find use wear. Nevertheless Dr. Kay recommends analog experiments for taphonomic processes, too, just as for use wear. That's why Dr. Pevny is conducting her own backyard soil-sheen experiment with the help of Jim Wiederhold. About five years ago Pevny and Wiederhold microphotographed replicated bifaces, blades, and flakes before burying them in buckets filled with Texas clay. The stone artifacts have been experiencing Texas wet/dry cycles for five seasons now. Someday soon they'll dig up the replicas and examine them again. "I don't know if we'll see anything in only five years," Pevny admits. "I don't know how long it takes for that type of damage to occur. But if we don't see anything we'll take more pictures, rebury them, and let them sit another five years."

Wiederhold scraping a bison hide with a hafted stone endscraper (*left*) and at his microscope.

Gauging the incidence of false use wear

Trampling, another post-depositional process, was Pevny's first experiment related to use wear. At the Gault site, Pevny analyzed about 70,000 pieces of Clovis-age debitage (flakes and broken flakes) from a workshop area (Excavation Area 8) in hopes of identifying use wear on expediently made stone tools, what she calls “the plastic knives and forks of the archaeological world.” Because lithic artifacts were found highly concentrated, flakes piled on top of flakes and many with broken edges, trampling was suspected as a probable cause of edge damage that could be confused with use wear. Following the method described in a 1998 article in *American Antiquity* by McBrearty et al., Pevny, with the help of fellow student and expert flintknapper Bill Dickens, laid out unmodified, unused flakes on a clay surface similar to the Gault site. In one area flakes were laid out singly, without touching one another; in the other test area flakes were layered two and three deep. Then the areas were subjected to substantial foot traffic. The results? Only one piece out of 319 resembled a tool after the trampling experiment; other flakes suffered damage, but not in a pattern that could be mistaken for use wear. Being new to use-wear analysis at the time, Pevny says the experiment gave her the opportunity to study the kind of unpatterned damage that can result from trampling.

Besides trampling, other analogs in Pevny’s experimental program included cutting, scraping, and chopping a multitude of materials—bone, antler, wood, sinew, fresh hide and rawhide—as well as butchering carcasses. If it sounds overwhelming for one person, you’re right. Luckily the crowd at CSFA operate like a well-oiled machine. Wiederhold, Smallwood, Dr. Dickens, Pevny, and Scott Minchak all collaborated on the experiments, and all benefited from them.

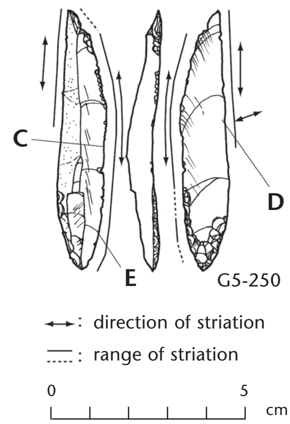
Surprises await the use-wear analyst

Thanks to microwear analysis, scientists are discovering that the shape of a tool isn’t always as telling as once thought. Endscrapers used to be categorized exclusively as hide-working tools. At the Gault site, though, Wiederhold found endscrapers smaller than those used to scrape bison hides. Although they may have started as hide-working tools, microanalysis shows that before they were discarded they were used to work harder materials like antler, wood, and bone.

The adz, a thick biface used to chop wood, was thought to be absent from the Paleoamerican toolkit until use-wear studies on suspected tools found at the Gault

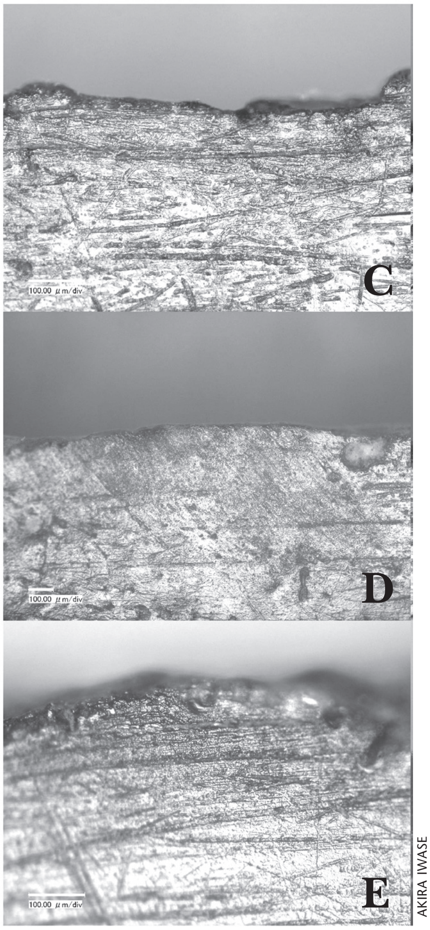
The Microscope
An Indispensable Tool

Here’s a splendid example of the prolific information that can be extracted from a stone tool by a skilled use-wear analyst, in this case Akira Iwase of the Graduate School of Humanities, Tokyo Metropolitan Museum. The artifact under investigation is a Sugikubo-type point from the Uenohara Paleolithic site in central Japan. The Sugikubo blade industry dates to 20,000–18,000 RCYBP.



Dr. Iwase chose this specimen, an obsidian point, because it showed signs of use, “remarkable striations accompanied by well-developed abrasion on both lateral edges.” A digital microscope (KEYENCE VHX) gave him these remarkable photos and made it possible to draw these conclusions:

> The striations running parallel to each working edge are formed both on the ventral and dorsal faces (**C, E**). At the halfway point along the left margin (with the piece oriented tip up and base down, and dorsal face visible), the striations extend obliquely to the working edge on the ventral face (**D**). The directions of striation suggest that this artifact was used for cutting or sawing and whittling. Although polish was not recognized, the marked abrasion suggests that these traces were formed by contact with a soft material such as meat or hide. The striations on the base suggest that this artifact was used without being hafted (**E**). . . . The use-wear traces described above suggest that Sugikubo-type points had at least two functions, as spear head and knife. . . . The impact fracture [seen on other specimens of Sugikubo-type points] and striation also indicate that some were used successively in hunting and butchering activities. . . . The hunter-gatherers probably developed these versatile tools to be adapted to the temperate forests of central Japan.



For Iwase’s complete description of these multifunctional artifacts, see “Use-Wear Analysis of Sugikubo-type Points from the Uenohara Site in Central Japan” in the 2009 edition of *Current Research in the Pleistocene*, vol. 26.

–*JMC*

site detected silica polish made by wood and telltale chopping striations that positively identify them as adzes.

Kay is constantly surprised by what he finds on the edges and surfaces of tools. While working at early metallurgy sites in eastern Europe, he found traces of fish scales on the surfaces and edges of stone objects that bore no resemblance to fish-scaling tools. In fact, before examining them microscopically he wouldn't even have guessed they had been used as tools at all. But even when a tool appears to fall into line perfectly with morphological and ethnographic analogies, Kay believes use-wear studies are still needed. "It is just the tip of the iceberg in terms of information that is available to us in a technological study of a stone tool," he cautions. "We ought to be able to figure out the tool edge, likely contact material, how long the tool was used in relative terms, whether it was maintained, and decisions about continued maintenance." Of particular interest to Kay are tool efficiency and the cost in time and labor to maintain a tool, to reshape and resharpen its edge. You've reached the point of diminishing returns when, like an old '77 Ford, the cost to repair it exceeds its value. Then it's time to trade up.

The trampling experiment, carried out on a footpath used by TAMU students: A, flakes laid out singly; B, piled one atop the other; C, all being walked on; D, the result; E, a flake from the lot where flakes were piled one atop the other. The uneven edge, discontinuous flaking, and small "notches" were caused by impact with other flakes, not by use.

ALL: CHARLOTTE PEVNY

Going forward

Wiederhold, a plain-talking advocate of common sense in the archaeological community, is realistic about weighing the impressive accomplishments of microwear analysis against its limitations. "This whole use-wear thing isn't completely infallible," he says. "It's not a be-all and end-all, it's just another line of evidence." He wants people to understand that, unlike the fictitious Holmes, a use-wear analyst can't simply examine a freshly excavated artifact under the 'scope and instantly conclude how it was used. Background information and experimental analogs are needed to deduce prehistoric behaviors from stone tools. Wiederhold finds a desperate need today for standardized procedures for use-wear studies. It isn't just the subjective terminology used—"Matte polish?" he grumbles, "what the heck does that mean?" More important for him is the need for a universal protocol of analog experiments that will make use-wear analysis "good science and make it fit the real world." He feels the time is right for another use-wear conference (the last one was held more than 30 years ago), where analysts from around the world can sit down together and agree on a set of quantified and standardized methods.

Without microscopic analysis, unfamiliar Paleoamerican tools might escape our attention entirely. Equally unacceptable is the possibility of prejudging a tool's use simply on the basis of its apparent morphology—if it looks like a sidescraper, then it must have been used as one. For Kay, use-wear analysis is a way of getting "basic information of tool function that is simply unavailable through any other means."

Elementary, my dear Watson.

–Dale Graham

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Early Hunters beneath the Great Lakes

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the sonar runs. This area, he promises, "will be high on the target list for ROV and scuba examination in the spring."

A preserved, undisturbed world

It's clear that lost worlds await discovery beneath the waters of the Great Lakes. Portions of the bottom of Lake Huron were dry land between about 10,000 and 7,500 years ago. O'Shea and Meadows offer persuasive evidence of amazingly well preserved cultural landscapes, including possible caribou drive lanes, soldier rocks, hunting blinds, habitation sites, and chert quarries and workshops. The ghostly images of these features lying on the bottom of Lake Huron are strikingly similar to structures constructed by caribou hunters on Victoria Island in northern Canada and elsewhere in the arctic and subarctic regions of North America.

What makes these discoveries especially exciting is that they are absolutely pristine sites. Many riches of the Paleoindian and early-Archaic cultures have been destroyed by human activity—decades of plowing, surface mining, development, and mischief wrought by curious explorers. At the bottom of the Great Lakes lie entire landscapes preserved from disturbance for more than seven millennia, potentially a remarkably complete record of human use of that ancient geography. Although O'Shea and Meadows have only begun their investigation of that record, they have already laid the foundation for a revolution in our knowledge of these early people.

–Bradley Lepper

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Suggested Readings

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Decoding the Woolly Mammoth

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might someday bring the entire species back from the dead. After all, we can now clone mammals if we put our minds to it, and Asian elephants are a sister species to woolly mammoths. If we could somehow build a fertilized mammoth egg, it could be brought to term by a surrogate elephant mother.

Hendrik Poinar makes no secret of his belief that this will, in fact, happen someday—probably within the next 50 years, if we get the right technology in line. And really, all that would take is a liberal application of money. But that begs a huge question: Would it be advisable to bring back mammoths 10,000 years along? "Now you're talking two different things," Poinar muses. "*Should* it be done? What are you bringing it back for? Certainly, there's no scientific reason to do it. You're not doing it to repopulate an area of the globe; you're doing it for financial gain, and that's the wrong reason."

Allowing that it would certainly be *interesting* to bring back the mammoth, the bittersweet reality is that we probably shouldn't—and ironically, we may not have to. Our technology has progressed so far, and our scientists are so clever, that we can tell an amazing amount about mammoths without resurrecting them at all. We'll take a look at one particularly fascinating case in point in the third and concluding article of this series.

–Floyd Largent

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