MAMMOTH TRUMPET

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Department of Anthropology
Texas A&M University
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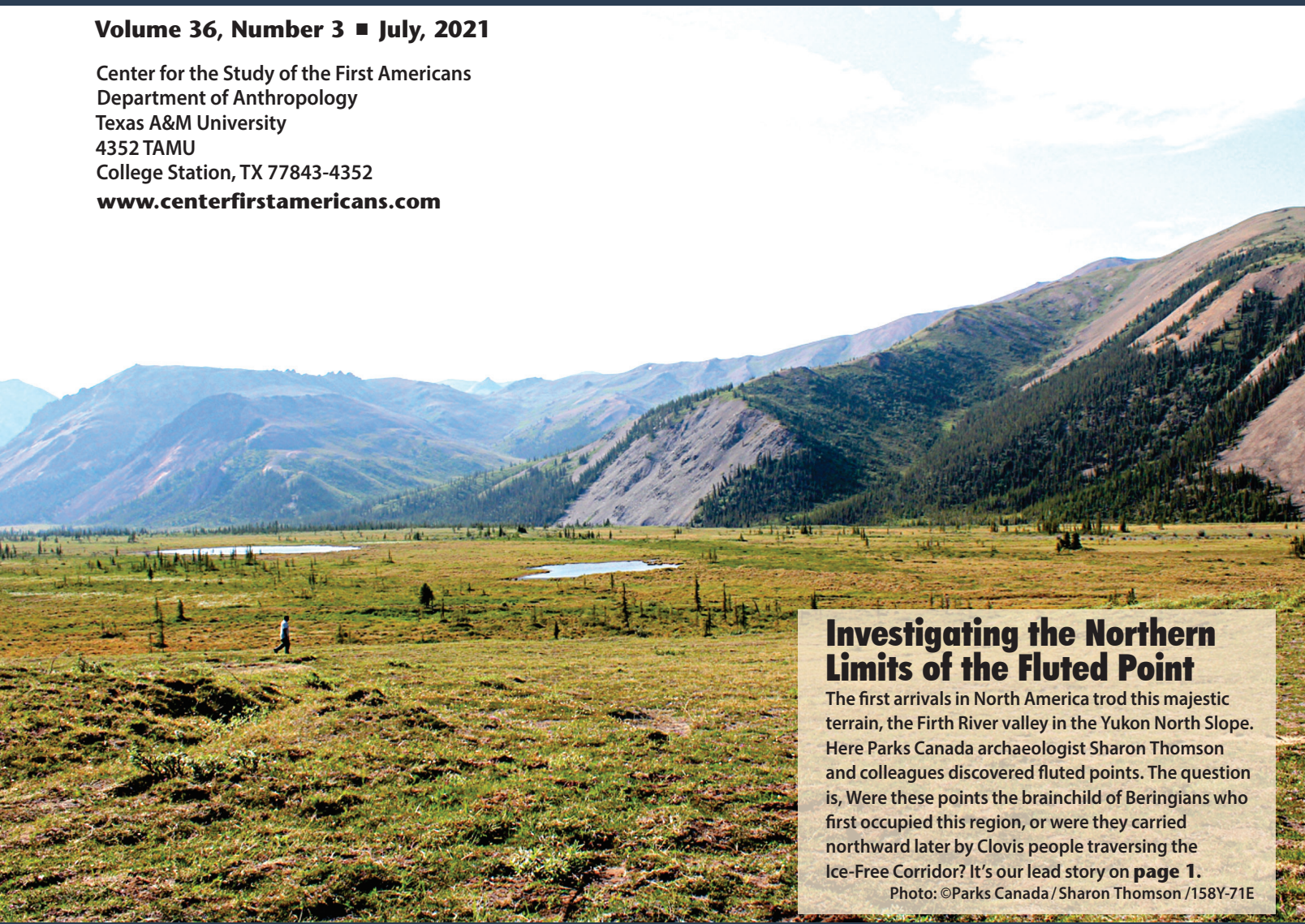

Investigating the Northern Limits of the Fluted Point

The first arrivals in North America trod this majestic terrain, the Firth River valley in the Yukon North Slope. Here Parks Canada archaeologist Sharon Thomson and colleagues discovered fluted points. The question is, Were these points the brainchild of Beringians who first occupied this region, or were they carried northward later by Clovis people traversing the Ice-Free Corridor? It's our lead story on **page 1.**

Photo: ©Parks Canada / Sharon Thomson /158Y-71E

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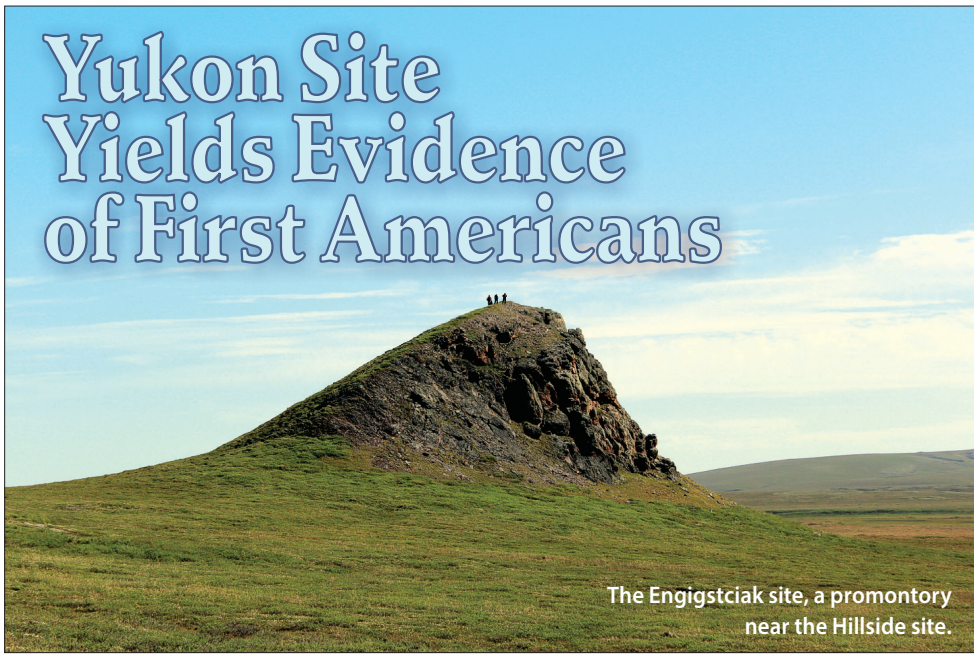
Yukon Site Yields Evidence of First Americans



The Engigstciak site, a promontory near the Hillside site.

PHOTO: ©PARKS CANADA/SHARON THOMSON/IMG_0265

INSIDE

THE NORTHWESTERN ARCTIC was the original gateway into the Americas. Whether the ancestors of the indigenous people of North and South America later followed the Pacific coast or traversed the Ice-Free corridor, this is where they first set foot in a New World (**MT 34-1, -2,** "Along the coast or down the Ice-Free Corridor: How did the First Americans get here?"). Surprisingly, however, there is little evidence for their passage along either proposed route. According to Heather Smith, Jeffrey Rasic, and Ted Goebel, who coauthored a 2013 overview of the early occupation of northern Alaska, barely a dozen sites in the region have been found that are more than 12,000 years old. This is why each new piece of evidence that archaeologists uncover in Alaska and the Yukon Territory is so important. Together, they help us read the opening chapter in the story of the First Americans.

It's not that such sites don't exist. They're just really hard to find. Bill Fox, an archaeologist with Trent University in Ontario, summarizes the problems. First of all, early sites are rare relative to later sites. In addition, they're scattered over a huge geographic area and can be hard to identify owing to a lack of what he calls "'neon light' diagnostics like fluted bifaces or microblade cores." Finally, archaeological surveys have barely scratched the surface of large areas of the north. Given all these hurdles, it's not surprising that locating early sites in this region is such a challenge.

The Hillside site

The Hillside site is a little-known early

site located along a high terrace of the Firth River in the northern Yukon. It was first investigated in 1958 by Richard MacNeish (**MT 16-2,** "In Memoriam: Richard Stockton 'Scotty' MacNeish 1918–2001"). MacNeish collected artifacts from the surface, noting that the cultural material was eroding from layers 1–2 m below the surface, which suggested that the occupation might be quite old.

Parks Canada archaeologist Gary Adams reinvestigated the Hillside site in 1995 to evaluate its state of preservation and to collect additional data about the potentially early occupation. Adams's crew found that extensive wind erosion along the western edge of the site had

WILLIAM FOX

Fox, 2020.

removed as much as 20 cm of soil. In surveying the large "blowouts," the team recovered numerous artifacts, including two fluted projectile points and additional biface fragments. The unpublished report of the survey identified one of the points as "typologically similar to other northern Clovis points although a little small," whereas the other was "less diagnostic." The report concluded that "the Hillside site is probably the most important intact site" in Ivvavik National Park for contributing to our understanding of the history of the Yukon North Slope, and recommended additional investigations.

In 2012 U.S. National Park Service archaeologist Jeff Rasic headed a collaborative project of Parks Canada and the University of Alaska Museum. Their goal was to produce detailed mapping and to perform stratigraphic investigations that would determine the extent of the ongoing erosion of the site. The team would also obtain samples for radiocarbon dating to establish the definite age for the early occupation of the site.

Following the trail of fluted points

Determining the age of the fluted-point occupation was important because archaeologists once believed that colonizers bearing spears tipped with fluted points were the first people to enter North America. Fluted points, however, have never been found on the western side of the Bering Straits, so the origins of this technology must lie somewhere in North America. The big unanswered question is, Where did toolmakers come up with the idea to add flutes to flint spear points?

Today archaeologists grapple with

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Department of Anthropology, Texas A&M University
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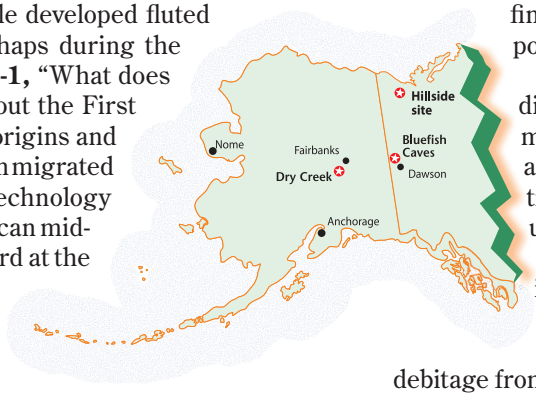
–Michael R. Waters, Director

two possibilities: Either people developed fluted points in the Far North, perhaps during the Beringian Standstill (**MT 35-1,** "What does the Y chromosome tell us about the First Americans, Part 1: Eurasian origins and the Beringian Standstill"), then migrated southward; or fluted-point technology originated in the North American mid-continent and spread northward at the end of the Pleistocene. The few dates we have for fluted-point sites in the Far North suggest they appeared there around 12,400–12,000 yr B.P., whereas the best current age estimate we have for Clovis fluted points across North America is 13,000–12,700 yr B.P. These dates support the idea of a south-to-north migration of fluted-point technology, but if someone discovers a fluted-point site in Alaska or northern Canada older than 13,000 yr B.P., that could change everything.



Back to the Hillside site

Parks Canada archaeologist Sharon Thomson was a member of the team that investigated the Hillside site in 2012. She recalls her first impressions of the site: "It's an incredibly beautiful landscape. It's situated in the lower reaches of the Firth River valley, where the British Mountains are beginning their descent to the Arctic coastal plain. It's at a point where the valley widens, and there are expansive views in both directions of the broad valley slopes rising to low mountains that fade off into the distance. Being unaffected by the last glaciation, the mountains that border the site are very rounded, with craggy tors of more resistant rock projecting from their peaks. You get a very strong sense of the antiquity of the place."

PHOTO: ©PARKS CANADA/PHILIP VARCOE (*LEFT–RIGHT*): 158Y1AST-1/PA-9303E; 30YS1AI-3/PA-9301; 30YS1B2-1/PA-9299E

Fluted point and fragments found at the Hillside site.

The team made one of its most important discoveries on the day they arrived. "After the helicopter dropped us off at the site," Thomson remembers, "we all spread out and began with a surface survey for artifacts, marking everything that was exposed on the ground surface with pin flags." Hiroo Sawada, the Western Arctic Field Unit's geographic information specialist, assisted with the surface collection. After finding a number of chert flakes, he found a fluted point—the third discovered at the site!

Sawada, not being an archaeologist, didn't immediately realize what he had found, but suspected it might be significant. He called for Thomson to have a look. She says, "I remember the thrill of recognition in the moment; I think the hair actually stood up on the back of my neck!"

The team excavated 7 25-by-25-cm units at 5-m intervals across the site and 3 1-by-1-m units. In the course of their work at Hillside they recovered many additional artifacts, especially chert debitage from the manufacture of stone tools.

Hillside site fluted points

The three fluted points from the Hillside site conform more or less to the size and shape of other northern fluted points found across Alaska and the Yukon Territory. Generally they're smaller and wider than classic Clovis points, with a deeper, V-shaped rather than U-shaped indentation at the base. Researchers tested the edges of the fluted point found in 2012 for chemical residues in the hope that they could identify the animals ancient hunters had killed, but the test failed to detect traces of blood proteins.

All three points from the Hillside site appear to be made from the same light-gray chert. Fox observes that the chert is visually similar to chert from outcrops located at the Engigstciak site, another early site investigated by MacNeish in the 1950s. It lies down river from Hillside and overlooks the Firth River a short distance to the northeast. A deep deposit near the knoll is known as the "Buffalo Pit" because MacNeish and his crew recovered butchered bison bones from the oldest deposits in the pit. Fox points out that the knoll would have made "an excellent game lookout" and suggests that the people who occupied the Hillside site may have traveled periodically to Engigstciak to stock up

PHOTO: ©PARKS CANADA/SHARON THOMSON/158Y-24E

Crew members Darrin Hansen (*left*) and Mervin Joe recording artifacts.

with toolstone and to hunt bison on the nearby coastal plain.

Heather Smith, Jeffrey Rasic, and Ted Goebel, in their study of early sites in Alaska, found they tend to be located near sources of high-quality toolstone or in places that offer commanding views of the surrounding landscape. The Engigstciak site meets both these criteria, and the Hillside site might be another example. Thomson suspects that the fluted points they found may have been made of chert from outcrops on the rocky bluffs overlooking the Hillside site.

According to Smith, Rasic and Goebel, the activities at these early sites focused on the "procurement and transport of high-quality raw materials" and the manufacture of tools, especially spear points. The evidence suggests these early groups moved frequently and over great distances, perhaps seasonally, in search of big-game animals. Thomson agrees with their assessment. "Although we have to be cautious about using modern conditions as an analog for past conditions," she remarks, "it is nevertheless suggestive that today, the low mountains in the area are crisscrossed with game trails, and game drives marked by stone cairns are present along the canyon edge not too far down river. The site has good visibility up and down the valley, which would have served as a natural travel corridor for people and animals alike." She believes that "the availability of game was probably a major factor in the occupation of the Hillside site" as it was at Engigstciak. It appears that this area has been a rich source of game since people first walked into this valley, whether from the north or from the south, 13,000 or so years ago.

Thomson examining an emptied meat cache, Western Arctic.

Another piece of the puzzle

The Hillside site is important because it has produced more fluted points than any other site in northern Canada. Rasic, in his report on the 2012 investigations, concludes that the site has "great potential to teach us about life at the end of the last ice age." For Fox, "it's another piece of the puzzle concerning Arctic fluted-point technology." Thomson points out that the Hillside location "at the eastern limit of the Beringian refugium" has the potential "to contribute to the discussion of whether northern fluted points indicate human population movement from south to north along a Canadian ice free corridor or interaction between Clovis peoples in the south with populations already in the northern Yukon and Alaska."

Fox agrees and suggests that the generally small size and distinctive shape of the Hillside site fluted points hints at a possible connection to the early occupation at Charlie Lake Cave in British Columbia, where archaeologists found a small basally thinned point associated with butchered bison bones. This early occupation dates to 10,500 RCYBP (about 12,350 yr B.P.), which supports a relatively late northward movement of Paleoamerican bison hunters through the Ice- Free Corridor.

All agree that such a major fluted-point site at the gateway to the New World certainly has a lot to teach us about the First Americans.

Parks Canada preserves the Hillside site as part of Ivvavik National Park, the first national park in Canada to be created as a result of an Indigenous land-claim agreement. The park is managed cooperatively with the Inuvialuit, the Western Canadian Inuit people.

–Brad Lepper

How to contact the principals of this article:
Sharon Thomson
Archaeologist
Indigenous Affairs and Cultural Heritage Directorate
Parks Canada
e-mail: sharon.thomson@canada.ca

William (Bill) Fox
Adjunct Professor
Anthropology Graduate Program
Trent University
e-mail: williamfox@trentu.ca

Suggested Readings

Rasic, J. 2012 Hillside Archaeology Site. Quliaguuq, Western Arctic Field Unit Update, Fall 2012, p. 3. Parks Canada.

Rozell, N. 2020 Archaeological sites show how people lived in a part of the Brooks Range known for extreme weather. *Anchorage Daily News,* April 11, 2020; https://www.adn.com/alaska-news/science/2020/04/11/archaeological-sites-show-how-people-lived-in-a-part-of-the-brooks-range-known-for-extreme-weather/

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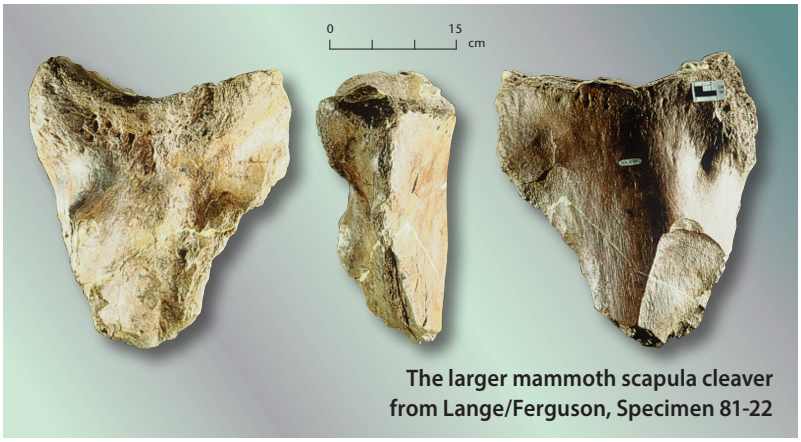
Part 2

A Clovis Mammoth-Butchery Site in the South Dakota Badlands

Lange/Ferguson

ONE OF THE MOST INTRIGUING Clovis localities in the U.S. is tucked away in the Badlands of South Dakota, an area where, until 1980, most professional archaeologists believed there were no Clovis sites at all. Adrien Hannus and his team proved that consensus wrong at Lange/Ferguson (39SH33), which lies in two small buttes in the heavily eroded White River valley. There, they uncovered a double mammoth-butchery site where at least three Clovis points and other stone tools were used in conjunction with the animals' own bones to take them apart.

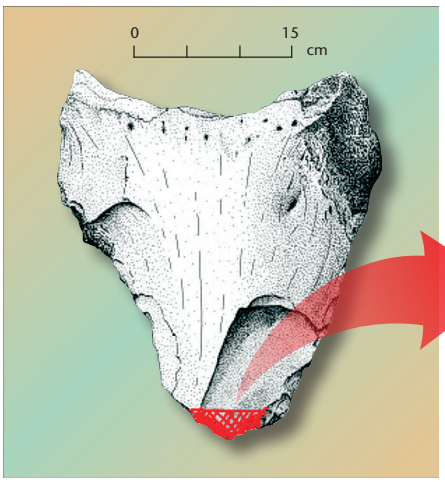
In part 1 of this report we discussed the discovery, excavation, and formation of the site, as well as the butchering process. In this article we'll take a closer look at the tools used.



The larger mammoth scapula cleaver from Lange/Ferguson, Specimen 81-22

Precious stone

Only one lithic artifact, Specimen L-80-1, was found in direct association with the mammoth bone bed. "If there had been any [other] stone we would have found it," Hannus notes. "We screened the sediments through 500-micron mesh, and there weren't even any micro-flakes." L-80-1 is an interior (tertiary) flake made of butterscotch-colored Scenic chalcedony, a toolstone popular among the local prehistoric Native Americans. It displays significant use wear on both the interior and distal edges, indicating "contact with a yielding, relatively soft material such as ligaments, tendons, or possibly cartilage," according to lithics analyst Marvin Kay.



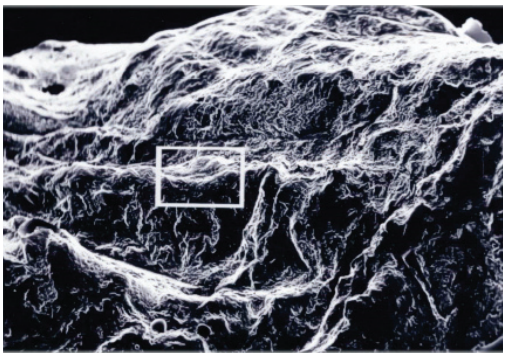
PATRICIA SHIPMAN

Hannus recalls exposing the tertiary flake in direct association with the head of the adult femur. The flake probably spalled off a chopper used to chop into the joint capsule and was apparently used as an expedient tool after it spalled.

The three other lithics from Lange/Ferguson, two intact Clovis points (specimens L-81-1 and L-84-1) and the basal fragment of a third (L-84-2), came from Locality B. They're all made of fine-grained chert; L-84-1 (the largest) is black, L-81-1 is reddish-brown, and L-84-2 is a weak red. All possess "distinctive microscopic wear traces indicative of prolonged and progressive tool use," according to Kay. The use wear indicates they saw use as knives, possibly after they were used to kill the mammoths. Hannus believes they were deliberately discarded. All three appear to have been resharpened repeatedly during the butchering process, and two retain traces of their life as spear points: impact penetration in the case of the L-84-1, hafting wear on L-84-2.

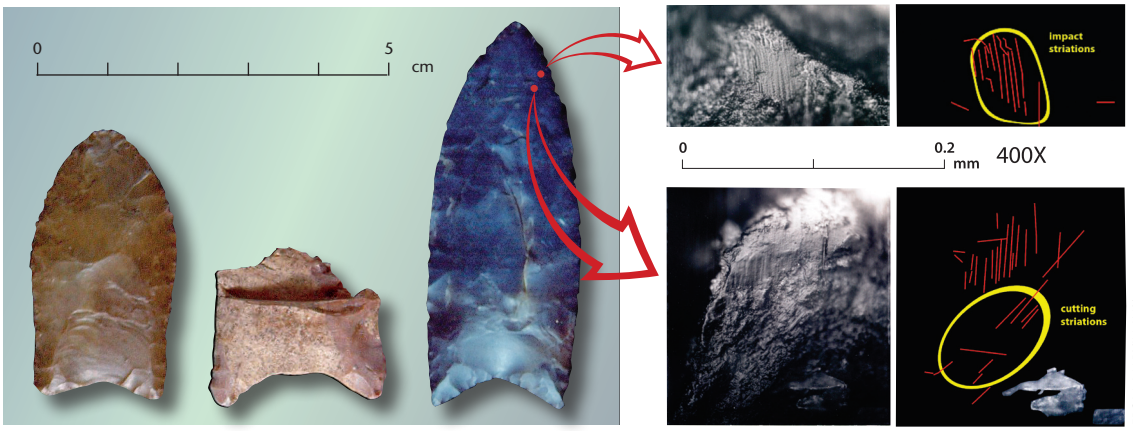
At first glance it may seem odd that more lithics weren't found at the site, especially since a quarry with high-grade chalcedony and chert is located scarcely 1 km distant. But according to Patricia Shipman, a bone-modification analyst highly regarded for her study of bones converted to tools, who conducted a microscopic analysis of the bone tools in the 1990s, "They may not have wanted to leave the carcass to go searching for stone. A whole carcass represents a lot of meat and fat that scavengers might be attracted to, so retaining possession of the carcass and keeping other humans as well as other predators away would have been an obvious concern."

It's also likely that the hunters were conservative in their use of lithic tools; those recovered were apparently only the deliberately discarded ones that survived the down-cutting event that formed the buttes 5000–6000 yr B.P. Moreover, as Hannus points out, "the bones were super-expedi-



One face of the large scapula cleaver (*left*), showing the area analyzed microscopically for use wear.

The area hatched in red at 15.7x magnification (*right*), showing features suggesting use as a tool, including hinge-fracture flaking and smoothing.



Lange/ Ferguson Clovis points (*left*). They have been "smoked" with ammonium chloride to enhance flake scars and mask material differences.

Use wear on the largest Clovis point (*right*). Note the impact and cutting striations.

ent tools. Bone flakes are razor-sharp at first, and just as good as the edges on lithic materials."

So let's take a look at those bones—another factor that makes Lange/Ferguson not just rare, but famous in Paleoamerican circles.

The story in the bones

Dozens of bones from Lange/Ferguson were fashioned into tools and used on-site, with perhaps the most convincing piece being the juvenile bone shard found between the vertebrae of the adult. That didn't happen naturally. For Hannus, it confirmed a butchering event. What's more, a bifacially flaked scapula was found in the rib cage, used as a sawing tool to cut through the meat around the ribs. When that piece was analyzed, Hannus's team couldn't realistically imagine taphonomic processes capable of removing it and detaching the flakes. "Those may be our best two pieces proving the butchery," Hannus declares. "Taphonomic agencies didn't seem reasonable in these cases."

Over 100 bone artifacts were recovered from Lange/Ferguson, but not all were made from mammoth bone—an indication of systematic use of bone tools for butchering prey. Of the 57 bone artifacts formally described, one is a flaked equine tibia with a helical (green-bone) fracture, showing microscopic use wear that suggests it was a flesh-working tool. Three others were fragments of a mule-deer tibia and femur. All exhibit helical fractures, and the tibia fragment bears both an obvious cutmark and microscopic use wear.

The tibia bone flake (*left*) and tibia core, which refit.

The 53 mammoth-bone artifacts include two scapula fragments used as cleavers; a punch; a flake cutting tool; a rib fleshworking tool; a tibia core; three long-bone cores; a rib core; and 14 other flakes derived from long bones and scapulae. The rest are fragments of long bones, scapulae, ribs, crania, a tibia, and femurs. All show evidence of deliberate breaking or flaking in the form of helical fractures and flake scars, the latter sometimes overlapping. The flake scarring and other reduction features, including loading points and, in one case, a hinge fracture, are easily visible.

The scapula cleavers, Specimens 81-22 and 81-32, are arguably the most spectacular of the bone tools. Both were manufactured in place from the left scapula of the adult. They're enormous: Specimen 81-22 is 33.5 cm long and weighs 6.1 kg; 81-32 is 45.5 cm long and weighs 3.3 kg. The cleavers are flaked on both faces to form chopping edges likely used to separate large chunks of meat and split bones at the joints. Other notable tools include the punch, made on a fibula with one end flaked to form a point, and the various fleshworking and possibly hide-working tools. Two of the artifacts, a bone flake (Specimen 81-154} and tibia core (Specimen 81-304), fit neatly together.

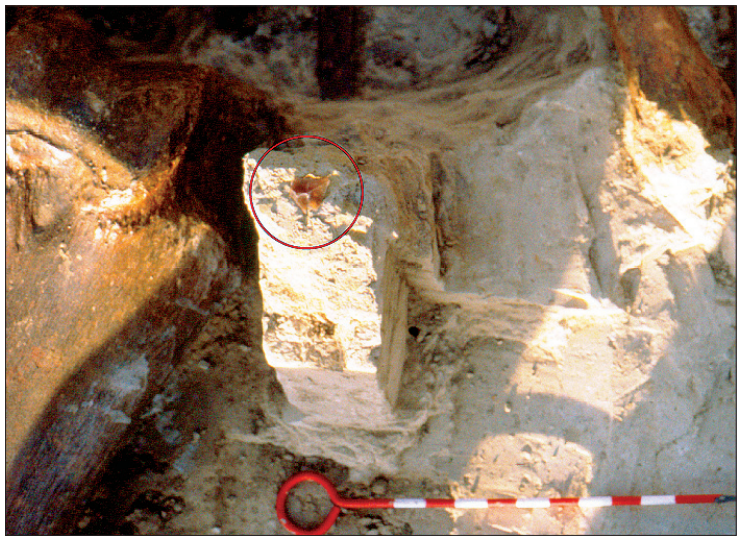
Laboratory analysis reveals only a few minor vertical cutmarks on the non-tool bones, rather than the more extensive cutmarks often observed when prey animals are completely defleshed. Hannus ascribes that to the sheer size of the mammoth: "This animal probably stood 14 feet at the shoulder, and was 8 to 9 tons in live weight. The amount of meat was huge, so there was no reason to do the kind of fine butchering you get on smaller mammals. It was disarticulated completely in place; the lower parts, including the forelegs, were never touched, except for a few parts that were moved around."

The bone preservation was excellent, Hannus notes, at least as good as any mammoth bone he has seen aside from a few permafrost carcasses from high northern latitudes. It was, in fact, the high degree of preservation that convinced Hannus that butchers had used the bones as tools; few of the flake scars were significantly eroded, and the flakes themselves retained typical flake characteristics, including hackles, loading points, and flaking cones (a.k.a. bulbs of percussion). The team proved the human origins of the bone flaking to their satisfaction during subsequent years of research.

Shipman conducted a thorough macro- and microscopic analysis of the Lange/Ferguson assemblage, focusing on the

53 specimens of mammoth bone and the horse tibia interpreted as a flesher, and concludes that at least 31 of the bones were unequivocally broken by human agency. She detected visible negative flake scars on 52% of the specimens, most with multiple flake-cone or loading scars. She determined that those 52% were flaked when fresh. Seven of the tools, including the larger cleaver, display distinct microscopic use wear on some edges.

Ultimately, her analysis supports the hypothesis that Lange-Ferguson is in fact a butchery site, where the butchers used expedient bone tools, though not all the bones she examined were used as such. What appears to be use wear in the appropriate places on some of the purported bone tools is pretty convincing to her. "There is no question that mammoth bones could have been broken by other mammoths," she allows, "but I don't think that kind of event would mimic use wear only in the appropriate places, if Hannus's interpretation is correct."



Pedestaled tertiary chalcedony flake found in the mammoth bone bed. The bone to the left is an adult femur.

The upshot

Lange/Ferguson is a landmark Paleoamerican site for several reasons, not least the careful scholarship and extensive study presented in *Clovis Mammoth Butchery,* the lavishly illustrated, in-depth report published by Hannus and his colleagues through Texas A&M University Press in 2018. It describes how hunter-gatherers of the most widespread Paleoamerican culture systematically butchered two mammoth carcasses in a place where, until Hannus began his work, few researchers believed Clovis even roamed. It's the chronicle of a brutal but poignant event pursued with the aim of ensuring human survival.

Clovis people depended on bone tools for their survival. At about the same time Hannus began investigating Lange/Ferguson, Dennis Stanford, Richard Morlan, and CSFA founder Rob Bonnichsen proved that butchering a proboscidean is backbreaking work, even with stone tools (though, as Shipman notes, "They gained valuable experience in understanding what sort of stone tools worked best for which tasks"). She points out that while butchering most dead animals is relatively easy—you cut through the joints, whether it's a deer, cow, or chicken—"the difficulty of actually killing and then fully utilizing a mammoth is huge. It takes time and expertise and probably a good deal of muscle." It took Bonnichsen and his colleagues 18 solid hours to butcher a deceased zoo elephant, which was smaller than an adult mammoth ("The Ginsberg experiment: Modern and prehistoric evidence of a bone-flaking technology." *Science* 212 [4493], 438–40).

Just making bone tools was hard work. "From any flaking of bone I've ever done," Hannus says, "to effectively break it, you need to scrape off at least part of the periosteum coating. In this case, the scapula choppers had to be cleaned down to a point where they could be used as tools. Cutting down the meat tissue surrounding it would have been done fairly quickly, though. It's hard to conjure it up in an adequate way, since we're looking at animals that don't exist any longer; but they went through the meat quite rapidly, so there must have been other tools utilized. We just didn't recover them. The area with most of the juvenile might have provided evidence of additional tools." And, he points out, "It's funny how many of the sites now being argued as very early human activity lack lithics."

Despite initial skepticism that bone tools had ever been used on megafauna, Hannus and his team proved not only that it had happened in the South Dakota 13,000 years ago, but that the people involved used bones from the butchered animals. Despite their initial sharpness, they would have presented much more of a challenge than stone tools. Experience tells Shipman that bone tools lose their sharpness fairly rapidly compared with stone.

But bone tools were clearly used at Lange/Ferguson. Indeed, in Shipman's opinion, the most remarkable thing about Lange-Ferguson is that "Adrien and his team recognized very early on that they might be looking at the use of mammoth bones as tools to butcher a mammoth. Thus, they used extra care in documenting their finds and making sure the association between the bones, the broken bones, and the stone tool was solid as seen by those who might be skeptical."

The excavation was extremely difficult, but the results were, in their way, both revealing and sublime. "What's still very interesting to me is the serendipity of the entire exercise," Adrien Hannus says. "We first met Les Ferguson, he took us out there—and it all fell into place."

–Floyd Largent

How to contact the principals of this article:

L. Adrien Hannus
Archeology Laboratory
Augustana University
2032 South Grange Avenue
Sioux Falls, SD 57105
e-mail: Adrien Hannus@augie.edu

Pat Shipman
Adjunct Professor, Retired
Department of Anthropology
Pennsylvania State University
410 Carpenter Building
University Park, PA 16802

Rolfe D. Mandel

Finding Evidence of Early Humans in the Great Plains, Midwest, and Beyond

A deeply incised stream on the O2 Ranch in the Big Bend Region south of Alpine, Texas. Mandel systematically studies such extensive exposures to locate terminal-Pleistocene deposits, which may harbor deeply buried artifacts that predate Clovis occupations.

ROLFE MANDEL wears many hats. He's Director of the Kansas Geological Survey, where he serves as State Geologist. He's also Senior Scientist and Executive Director of the Odyssey Archeological Research Program. No newcomer to the field, Mandel has spent 40 years working with archaeologists, where he focuses on the effects of geologic processes on the archaeological record.

"I've been curious about the peopling of the Americas since I was in high school," Mandel says, "and my curiosity increased when I entered college and read the works of Kirk Bryan, C. Vance Haynes, Jr., Elias Sellards, and George Frison. During the 1980s, my Ph.D. advisor, Dr. Wakefield (Wake) Dort, Jr., often talked about how many archaeologists were narrow-minded because they wouldn't consider the possibility of pre-Clovis people in the Americas. He was convinced that people arrived in North America during the Last Glacial Maximum, and he took me to sites in Kansas and Missouri that he thought were at least 15,000 to 20,000 years old. Visits to those sites increased my interest in the peopling of the Americas. Wake also thought that Quaternary geoscientists like me could prove that the Clovis-First paradigm was wrong and that I could play a significant role in the search for the material remains of the First Americans. I've always liked challenges!"

Born in San Antonio, Mandel moved to Austin to seek a bachelor's degree at the University of Texas in physical geography. From there he pursued graduate studies at the University of Kansas, then a Ph.D. in the KU Special Studies program. His focus was on projects relating to archaeology and cultural-resource management in the Midwest. In 2002 he accepted a position with the Kansas Geological Survey and switched to the Anthropology Department at the University of Kansas, where he was made full professor in 2009.

"Rolfe is the kind of professor who builds his students up," says Jared Beeton of Fort Lewis College in Durango, Colorado. "When I was his Ph.D. student at KU, he spent countless hours talking with me about research, writing, and all the complexities involved with soils and geoarchaeology. He has a way of building your confidence as a student. Maybe it's because his confidence rubs off on you; he's cool. It's rare to find a professor who cares this much about his students. And now over a decade since I graduated, he's still in my corner and I'll always be in his."

His heart is in America's heartland

Mandel's quest is to find evidence of the earliest humans on the central Great Plains. His tools are geology, geography, and paleoecology, and he has pioneered the use of lithostratigraphy in the search for the early archaeological record. Identifying topographical features that might have lured ancient peoples to hunt, fish, and camp in a certain place, however, is just the tip of the iceberg. Mandel believes the crucial element for investigations into deep human history is context. Context comes into play when cultural evidence is found in situ—buried and preserved in place. That's problematic in the central Great Plains, where, since the last Ice Age, wind-blown sediments have been eroded off the uplands and washed downstream, forming especially thick deposits in stream valleys. This process was assisted by large-scale changes in weather patterns across the central continent. Although the Central Plains became increasingly arid, massive storms eroded tremendous volumes of sediment that buried the archaeological record. Deep.

Leafing through layered prehistory

Work at the Clovis site in New Mexico in the 1930s launched a system of applying geoscientific methods to archaeological analysis. Today geoarchaeologic principles are applied to create predictive models for locating stratified late-Wisconsin and early-Holocene cultural deposits. Many of these sites are found in the High Plains of Texas and New Mexico and the Western High Plains of Colorado and Wyoming. Although Paleoindian projectile points occasionally turn up in streambeds and on

Among the earliest modern humans in Europe were hunters who settled beside the Danube 30,000 years ago. They chose the site well: It lay at the edge of the enormous ice sheet, which created a tundra-like environment that attracted mammoth and reindeer. With ample food year-round, they had the leisure to learn new skills. Excavations at the site in the modern Czech Republic, ongoing since 1924, reveal some of the earliest examples of textile and ceramic manufacture. They were gifted artisans, capable of creating stunning jewelry and figurines (notably the famous Venus of Dolní Věstonice shown here on the cover, an exotic, highly stylized female fetish). They practiced ritual burial, in one instance three young persons interred in a common grave.

Scientists will find the scholarly text of ***Dolní Věstonice–Pavlov: Explaining Paleolithic Settlements in Central Europe*** a valuable reference. Casual readers will enjoy the beautifully executed scenes of Paleolithic life inspired by archaeological finds over the past century. Those who enjoy Jean Auel's *Clan of the Cave Bear* will find intriguing the fact that the author credits the technical accuracy of Paleolithic life expressed in her novel to research at Dolní Věstonice. See the outside rear cover of this issue for ordering information.

Jiří A. Svoboda served as principal investigator of the Dolní Věstonice site from 1985 until he retired in 2019. He is coeditor of *Early Modern Human Evolution in Central Europe: The People of Dolní Věstonice and Pavlov.* Translator **Suzanne Dibble** has served the English-language needs of publishers, universities, and other institutions throughout the Czech Republic.

uplands of the Central Plains, the vast region boasts few in situ camp and kill sites. Superficial archaeological investigation in the past in Kansas and Nebraska may account for this dearth: Shallow shovel testing and surface surveys have yielded meager results, and deep subsurface exploration isn't commonly practiced.

In a 2008 paper published in *Geomorphology,* Mandel argues that in the Central Plains the paucity of recorded early sites often found in other areas of the Central Plains and along the eastern Rockies shouldn't be construed as evidence that early humans weren't there. What's needed to address the question, he declares, is a systematic study of late-Quaternary landscape evolution in the Central Plains. Are buried soils of Paleoindian-age landscapes preserved in stream valleys throughout the region? If so, where in the drainage networks are they likely to occur?

To answer his own question, Mandel has conducted a multi-year investigation of late-Quaternary alluvial fills in the valleys of low- and high-order streams across the Central Plains, with emphasis on interpreting landscape evolution during the Pleistocene-Holocene transition. Because the study was designed to provide a geoarchaeological model, it also explored how erosion and sedimentation may have affected Paleoindian-age alluvial landscapes throughout the Holocene.

In the course of the study Mandel documented deeply buried paleosols that are relicts of Paleoindian landscapes, from the moist sub-humid forest-prairie border of the east Central Plains to the dry sub-humid and semi-arid shortgrass prairie of the west Central Plains. Mandel found paleosols in the valleys of large streams and draws, and beneath alluvial fans (triangle-shaped landforms created by swiftly flowing water as it descends from uplands) in areas of western Kansas covered by thick loess mantles. He documented buried soils dating to about 12,600–9000 yr B.P. underlying fans throughout the region.

The results confirm that alluvial deposits and soils associated with stream systems are indeed systematically preserved. Sites predating 9000 yr B.P. , he concludes, will be found only where geologic deposits are old enough to contain them. Those deposits are likely to occur beneath stream terraces and alluvial fans, and the archaeological record is most likely associated with buried soils representing former surfaces that remained stable long enough to develop recognizable soil-profile characteristics. In this common-sense advice we hear echoes of another geoarchaeologist, Loren Davis, whose watchword for those seeking ancient sites is DORA—"Learn where 'dirt of the right age' can still be found in remnants of ancient terrestrial landscapes" (**MT 36-2,** "Loren Davis: Validating a Pacific Coast entry route"). Geoarchaeologists Mandel and Davis are both singing from the same page of the hymnal.

No, the dearth of recorded stratified Paleoindian sites isn't an indication of sparse early human occupation. Instead, Mandel's study confirms that we simply haven't dug deep enough in the right places.

An enormous, volatile study area

The Central Plains region Mandel studied extends from northern Nebraska south through Kansas and a bit of northern Oklahoma. The area includes seven physiographic subprovinces: the High Plains, Nebraska Sand Hills, Loess Plains, Smoky Hills, Arkansas River Lowlands, Red Hills, and Wellington-McPherson Lowlands. As you can imagine, an in-depth study of these diverse areas is no small undertaking.

The climate of the Central Plains exhibits a wide range of temperatures and a distinct east-to-west precipitation gradient. Annual precipitation ranges from about 100 cm at the eastern edge to less than 40 cm in the west. Three quarters of annual precipitation falls from April to September, largely as a result of frontal activity. Pacific and polar air masses flowing south into the area meet warm moist maritime tropical air flowing north from the Gulf of Mexico, often producing intense rain-

The 2003 Odyssey excavations at the Claussen site along Mill Creek in northeastern Kansas. Mandel discovered the site in 1999 in a survey of the stream valley. Fieldwork discovered stratified Dalton (Late Paleoindian) cultural components more than 8 m below the surface of the alluvial terrace in the foreground, and a single hearth with charcoal dating to about 12,550 yr B.P. about 3 m below the deepest Dalton component.

The exterior of the San Esteban Rockshelter in the Big Bend region of southwest Texas. A tinaja (cavity carved by spring waters) in front of the rockshelter makes the site an oasis in the northern Chihuahuan Desert. The KU Odyssey Research Program and the Sul Ross State University Center for Big Bend Studies, which have been excavating the site since 2019, found a nearly continuous archaeological record that may go as far back as the terminal Pleistocene.

The KU Odyssey team excavating the Coffey site. The site was occupied continuously for the past 6,000 years. Mandel decided to look deeper; investigation during 2011–15 discovered a Folsom component and perhaps an earlier occupation.

The interior of the San Esteban Rockshelter. Despite massive blocks of roof fall, teams gained access at small open areas in the back of the shelter and excavated cultural deposits in Holocene and terminal-Pleistocene loess.

Mandel and KU archaeologist Jack Hofman inspecting artifacts marked with pin flags at the Coffey site along the Big Blue River in northeastern Kansas. The artifacts lie nearly a meter below a Folsom component and may represent a Clovis or pre-Clovis living surface.

TRAVIS HEYING

Mandel inspecting mammoth remains dating to about 14,500 yr B.P. in a deeply buried bone bed discovered at the Kanorado locality in northwestern Kansas. Spiral fracturing and other forms of bone modification suggest that the bone bed represents a pre-Clovis cultural deposit.

Penetrating Nature's Disturbances

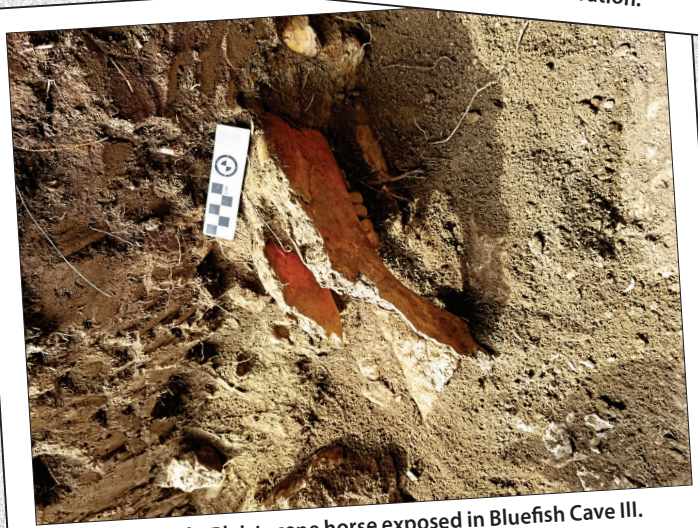
Mandel (*far right*) and benefactor Joe Cramer (*checkered shirt*) examining camel and mammoth bones exposed during excavations by the Odyssey team at one of three sites at the Kanorado locality in northwestern Kansas. The bones date to about 14,500 yr B.P.

At the Scheuerman site on the High Plains of western Kansas, the remains of an adult and juvenile mammoth were exposed during construction of agricultural terraces. The bones date to about 16,200 yr B.P. A dense concentration of about 1,000 artifacts was found about 50 m from the mammoth remains and at the same depth.

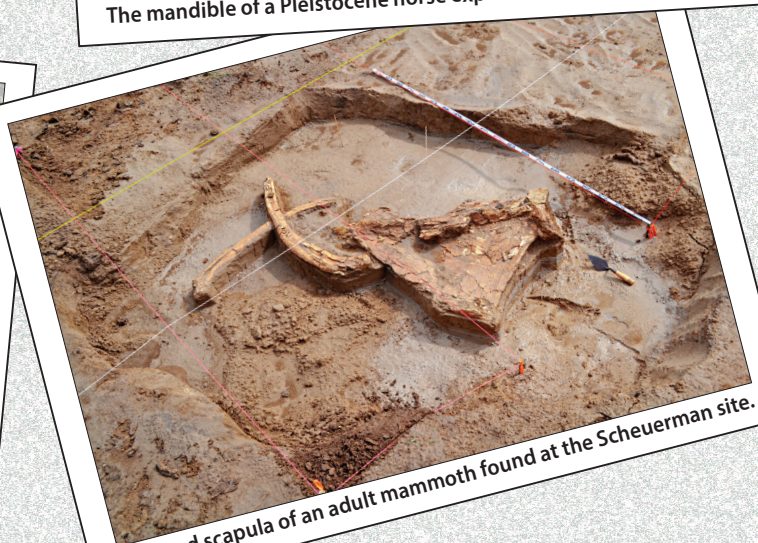
KU Odyssey team excavating the Scheuerman site. Investigation the site occupied five seasons.

The Bluefish Caves in the northern Yukon Territory of Canada may constitute the earliest evidence of humans in North America.Radiocarbon ages range from ca. 12,000 to 24,000 yr B.P. The stratigraphic context of the cultural deposits defined 50 years ago by Jacques Cinq-Mars, however, has been challenged, and the site-formation processes are unclear. In 2019 Mandel, with geneticists Dennis O'Rourke and Lauren Norman and anthropologist Lauriane Bourgeon, sought artifacts directly associated with Pleistocene fauna remains and collected sediment for environmental DNA analysis.

Here O'Rourke, Norman, and Bourgeon are preparing an area in front of Bluefish Cave III for a test excavation.



The mandible of a Pleistocene horse exposed in Bluefish Cave III.



Ribs and scapula of an adult mammoth found at the Scheuerman site.

falls of short duration. Strong high-pressure areas in the upper atmosphere over the midcontinent tend to promote drought in the western region. In fact, extreme droughts have periodically afflicted the Central Plains at intervals of about 20 years, wreaking dramatic changes in the grassland and vegetation, and strong evidence suggests the occurrence of "mega-droughts" during the Holocene, perhaps lasting hundreds of years, which would have drastically perturbed plant communities and severely impacted early Americans.

Systematic study methods

Mandel's step-by-step investigation proceeds by first mapping geomorphic surfaces and landforms, then sampling and analyzing late-Quaternary alluvial fills throughout the entire study area. Soils are identified, described, and listed numerically beginning with #1, the modern surface. To identify the age of buried landscapes, organic soil matter was radiocarbon-dated at the University of Texas Radiocarbon Laboratory and labs in Illinois and Arizona.

Mandel collecting soil cores in the Neosho River valley of east-central Kansas. Cores yield soil-stratigraphic and chronological information that inform him of the potential for finding buried archaeological materials from early cultural periods. Looking on are his former doctoral students, Dr. Laura Murphy and Dr. Andrew Gottsfield.

Frequent fires may have removed ground cover and accelerated erosion in early- to mid-Holocene. Sediment carried by streams was deposited on alluvial fans and floodplains (now terraces), thus burying Paleoindian-age landscapes often to a depth of as much as 3–5 m. These buried landscapes can be targeted in archaeological surveys that use deep exploration methods like coring, trenching, and stream-bank inspection. This approach could shine new light on the early archaeological record of the Central Plains.

Mandel's 2008 article published in *Geomorphology* resulting from this study won the Geological Society of America Kirk Bryan Award for Excellence in 2010. The award presentation referred to the article as "a masterful merging of stratigraphic, geomorphological and archaeological data across the Central Plains that addresses long-standing questions in fluvial geomorphology and stratigraphy, landscape development and cultural history."

Praise from his colleagues anticipated Mandel's awards. "Rolfe is the most generous guy I know," says Art Bettis, professor emeritus of the University of Iowa, who has collaborated with him for 40 years, "generous with his time, information, ideas, and advice. I consider myself extremely fortunate to be his colleague and friend. After a hot, muggy day in the field there is no one I would rather share a beer (or six pack) with in a seedy motel."

The Kansas Geological Survey

In 2002 Mandel took a position at the Kansas Geological Survey as a part-time project coordinator for the Geoarchaeology Research Program. He was also serving as editor-in-chief of *Geoarchaeology: An International Journal*. He stepped down from that position in 2004, but currently serves as associate editor.

After 10 years in the Geography department at KU, he switched to the Department of Anthropology (where he was made a full professor in 2009) and became an associate scientist at the KGS. There he would take charge of the newly created Odyssey Geoarchaeological Research Program.

Odyssey Geoarchaeological Research Program

An ongoing research program funded by a generous endowment from Joseph and Ruth Cramer, philanthropists whom Mandel describes as "consumed by a curiosity about who was here before us," the program is housed in the Kansas Geological Survey at the University of Kansas. Mandel, who had met Cramer earlier when he invited him to a dig underway in northwestern Kansas, was appointed director. The goal of the program is "to search for evidence of the earliest people to inhabit the Central Great Plains and western portions of the Midwest, and to gain a better understanding of the late Pleistocene and early Holocene paleoenvironments that affected these people."

Along with a strong field-oriented research program, Odyssey has laboratory components and specialized facilities at the Kansas Geological Survey.

Big questions facing today's scientists

"I think people arrived in the Americas during or even slightly before the Last Glacial Maximum (LGM), perhaps as early as 34,000 years ago," Mandel tells us. "At the Bluefish Caves site in the northern Canadian Yukon, cutmarks on faunal remains dating to about 24,000–23,300 yr B.P. appear to be the products of butchering. On the North Slope of Alaska, sediments dating from about 34,000–16,000 yr B.P. from Lake E5 and Burial Lake have yielded human-fecal biomarkers. I'm confident that evidence of a human presence during the LGM eventually will be found in the mid-latitudes of North America."

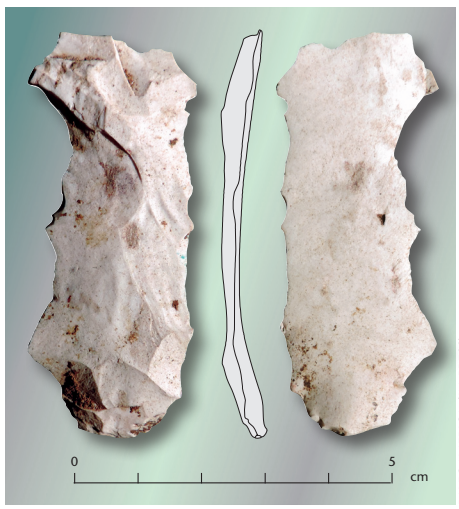
Determining when people entered the Americas and subsequently migrated south of the Laurentide Ice Sheet is the most challenging and important question geoscientists should be addressing, according to Mandel, but he has other questions, too:

continued on page 17

Is that artifact really Clovis? A case in point...

WHEN A TEAM of researchers excavated the Goodson Rockshelter in Oklahoma, they were sure it was a Clovis site because excavations produced artifacts that bore unmistakable earmarks of Clovis biface and blade technology. Lead author Brian Andrews of Rogers State University later presented a paper on these tools at the 80th annual meeting of the Society for American Archaeology.

Everyone who attended the talk agreed that it must be a Clovis site. But when coauthor David Meltzer of Southern Methodist University sent samples from the lower layer, Stratum 1, for radiocarbon dating, the calibrated dates were reported at 4500 yr B.P. (Holocene age) instead of 13,000 yr B.P. (Clovis age). Andrews and his team understand that things can move around in rockshelters and assumed the dates must be wrong. So they obtained an OSL date from the same layer. The OSL date was nearly identical to the calibrated C-14 date, about 4500 yr B.P.



PALEOAMERICA (IN PRESS)

How archaeologists are deceived

Excavations at Goodson Rockshelter produced artifacts bearing attributes considered by generations of lithics analysts diagnostic of Clovis lithic technology: fluted bifaces, overshot flaking, and prismatic blades. The artifacts were recovered, however, from a clearly delineated, unmixed stratigraphic layer dated to the mid-Holocene. For Andrews, Meltzer, and coauthor Metin Eren, Assistant Professor of Anthropology at Kent State University and Research Associate at the Cleveland Museum of Natural History, this episode shows that these technological attributes aren't unique to Clovis and cannot by themselves identify Clovis artifacts.

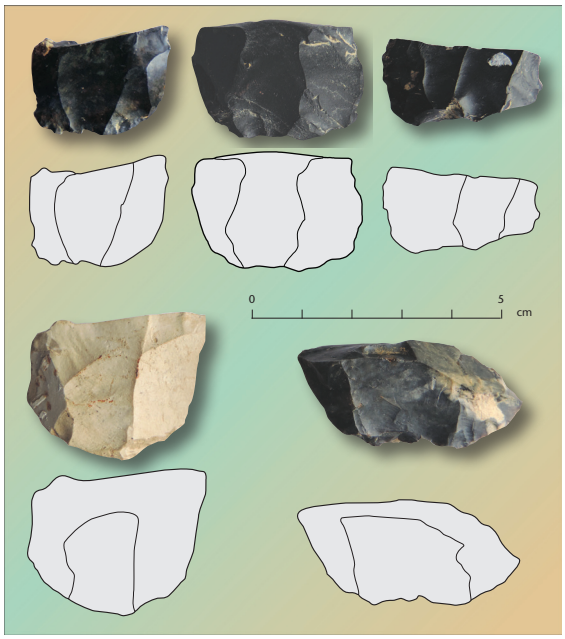
Eren explains that "Clovis may have a higher frequency of overshot flakes and fluting and blade technologies, but archaeologists haven't done their due diligence by looking as closely at Holocene stone technologies, and this is why Goodson Rockshelter is really interesting. The reason we started looking at it so closely is we thought it was a Clovis rockshelter, based on the fact that it had fluted bifaces and it had prismatic blades—as well as big bifaces with overshot flake scars."

Several specific attributes guide researchers in recognizing Clovis lithic artifacts, foremost among them the intentional use of overshot flaking (*outre passé*), a technique Clovis toolmakers perfected and used to reduce the thickness of bifaces—and whose presence archaeologists sometimes mistakenly believe exclusively identifies Clovis technology. Other distinguishing features include the kind of toolstone used; distinctive flake and blade platforms; methods of thinning and flaking; biface size and morphology; size, curvature, and reduction strategies of blades. When researchers identify an assemblage as Clovis, their decision is based on technological features diagnostic of Clovis lithic technology.

Eren remembers that, when the team first saw the OSL dates for Goodson Rockshelter, we thought, "'Okay, sand grains move around, this must be wrong.' We were so entrenched with the view that it must be Clovis." It wasn't until their third year, when the team found Archaic arrowheads in the same layer where they had found artifacts they thought were Clovis and made on exactly the same toolstone, that they spied the red herring. "These Archaic groups were using what we thought was Clovis technology," he says, "but actually, that's just what they did. They also fluted their bifaces and made prismatic blades." At Goodson, Eren found the whole "Clovis package" (except Clovis finished points), which is a rare happening even at actual Clovis sites.

Goodson Rockshelter lithic artifacts:
◀ **channel flake;**
▼ **fluted bifaces.**

The episode led Eren to two questions: How secure is the



Fluted bifaces from the Fox Lake site.

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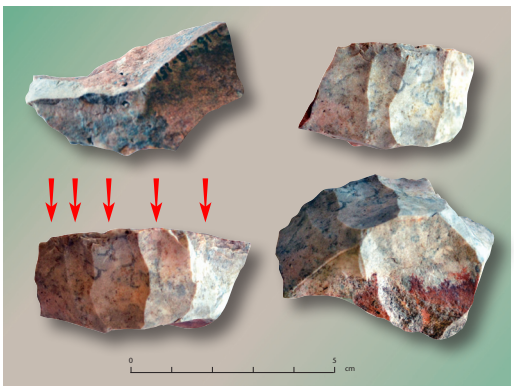
cultural affiliation of assemblages designated Clovis based on technology alone? And how can we explain the presence of "Clovis" technology in post-Clovis assemblages at sites such as Goodson Shelter?

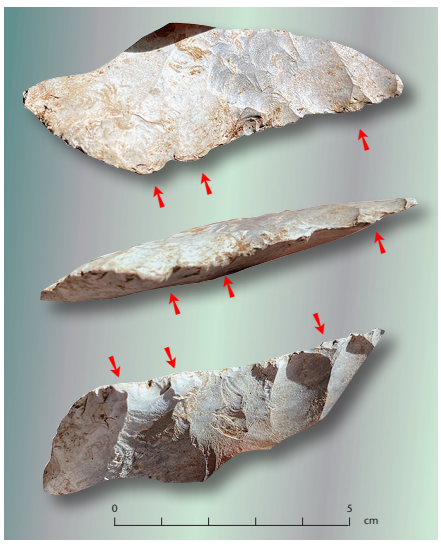
The questions came at a good time because Eren had just published his book *Convergent Evolution in Stone-Tool Technology*. He confesses now that "we used to think that stone technology was unique and so very nuanced that you could identify cultures based on this trait or that." This self-assured attitude in recent years has been flipped on its head. We now know that more convergence exists in lithic technologies than anyone could have imagined. To be safe, he says, "We should assume convergence is the default rather than think stone tools are unique. This makes sense. You can break rock in only so many ways. There are certain mechanical and physical constraints in place that only allow you to flake rock in certain ways. A knapper can't strike a spherical flake, for example. So by definition, it can't be unique in lots of ways."

Can we distinguish Clovis from non-Clovis?

The Fox Lake site in Ohio, like Goodson Rockshelter, is a site that appeared Clovis yet ultimately ended up being proved younger. At both sites, no finished Clovis points were found in the surrounding area, only Holocene points ranging from the Early Archaic to the Late Prehistoric periods. The two sites demonstrate instances where early- and middle-stage fluted bifaces are products of Holocene lithic technology rather than Clovis. Eren argues that early- and middle-stage fluted bifaces are likely found in multiple prehistoric contexts in North America and beyond and aren't therefore by themselves diagnostic of the late-Pleistocene Clovis culture.



Goodson Rockshelter prismatic blade cores ▲ with uni-directional blade removals (*arrows*).



Three views of Clovis-like ground, isolated, ▶ and projected platforms (*arrows*) on a Goodson Rockshelter biface.

PALEOAMERICA (IN PRESS)

"The more I start looking at post-Clovis things with the same detail I'd give to Clovis," Eren tells us, "the more similarities I find. At the moment, the only thing I see as different is simply the finished Clovis point. If a cache has a finished point in it, then we can say it's Clovis. Some people find a group of early-stage bifaces and say it looks like Clovis, but you can't actually say that anymore because now we know that post-Clovis people did things in a similar way. You really need a finished item."

If the fact that Holocene toolmakers practiced Clovis-style early- and middle-stage biface fluting seems surprising or controversial, the reason may be that lithics analysts have failed to examine Holocene lithic technology with the same rigor devoted to Clovis assemblages. Although an occasional study documents certain similarities between Clovis and Holocene lithic technologies, a rigorous comparison of the two is absent from the literature.

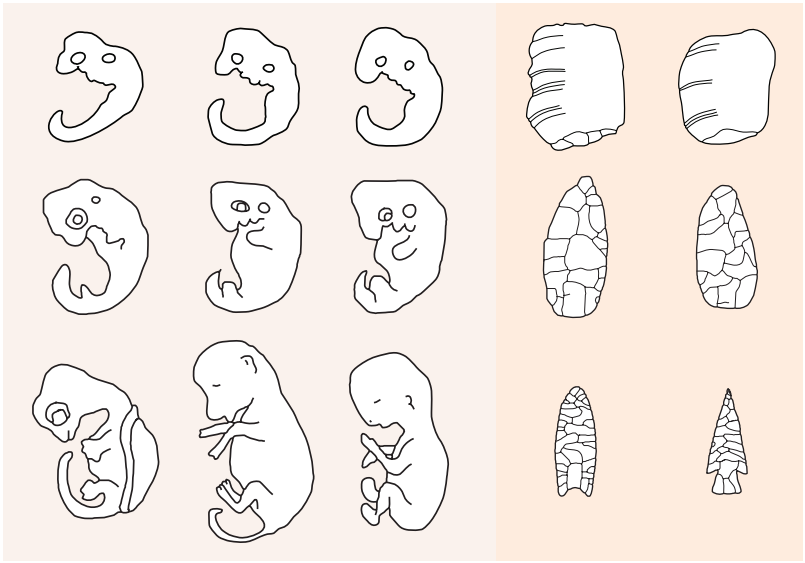
Why examine post-Clovis cultures?

Goodson and Fox Lake are illustrative cases of convergence between Clovis and Holocene lithic technologies. Eren wants to probe deeper to determine which constraints drive that convergence: developmental, functional, or some combination of the two. If developmental constraints are responsible, then Late Archaic knappers may have discovered flaking techniques that led to Clovis-like forms—in other words, they reinvented Clovis lithic technology. If functional constraints produced similar lithic technologies, then Clovis and Late Archaic peoples may have confronted similar challenges, for example, in procuring or processing resources.

Why are we seeing Clovis-like tools post-Clovis? Eren considers two possibilities. First, Late Archaic toolmakers may have practiced traditional Clovis technology, just as everyone in the previous 6,000–7,000 years had been doing as well. Or second, because we don't have a clear picture of variations in lithic technology in the millennia following Clovis, toolmakers may have abandoned Clovis technology until, in the Late Archaic, they spontaneously invented that technology again. Eren confesses that "we don't know if it was dependent on environment, or if there's a continuous tradition where they didn't invent anything, just

continued what was being done. We need more people looking at post-Clovis technologies to distinguish those two options."

Another avenue worth investigating is to determine whether certain traits appear more frequently in Clovis or in other cultures. Maybe a certain type of flake is found statistically more often in Clovis than in a post-Clovis culture. "But we can't do those kinds of analyses yet," Eren explains, "because we don't know the frequencies of those things in post-Clovis times." Again he laments the lack of a detailed post-Clovis database. "We're really at the beginning or even starting over with some of this stuff. We've never truly compared apples to apples before in North American technology. We've compared apples to this other thing we thought we knew but actually didn't."



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Different forms may appear similar at inception, then diverge during gestation (*left*) or the lithic-manufacturing process (*right*)

Sometime in the future, when researchers pore through collections and subject later cultures to the rigorous analysis that has been applied to Clovis, Eren expects we'll probably discover a startling number of similarities among post-Clovis cultures. The collections are there today. It's just a matter of scrutinizing them. As Eren puts it, "If you measure and record something in Clovis, you must measure and record the exact same thing in post-Clovis. That research equivalency hasn't been done. Maybe it's a prime research project for a doctoral student—an army of doctoral students!"

Eren, a master flintknapper of international renown, makes stone-tool replicas every day in the Kent State University Experimental Laboratory.

For Eren it's a matter of looking beyond the confines of a specialized area in lithic technology. In biology, let's say, you understand polar bears, but you've never looked at black bears or panda bears or anything except polar bears. Until now, Eren argues, analysts with an interest in Paleoindian technology haven't had a reason to explore later periods; they just assume the technology is different. To be sure, the immensity of the task Eren is campaigning for is staggering. A Clovis site may yield 100 artifacts. To examine them in detail is a far easier task than to analyze the thousands that might be found at a Holocene site.

It's an intimidating task, but for Eren a necessary one. "This should be scary for Clovis researchers because—I've done this myself—you look at a stone tool and say that it looks like Clovis. We can't say that anymore. Who knows how many things we have misidentified as Clovis because it looks like Clovis, but is actually from a later time period?" If we can better understand which post-Clovis cultures are similar to Clovis and which are different, then we can start asking more sophisticated questions as to why people are choosing the types of technologies they do. "At the moment we're assuming people after Clovis are different, so we've never asked that question, but once we understand what's similar and what's different, only then can we ask the broader question of why," Eren says.

The need to rectify past wrongs

Eren has in mind another formidable task, daunting but necessary: To reassess the multitude of early- and middle-stage fluted bifaces that have been assigned as Clovis. Many of these artifacts were discovered at stone outcrops that over time would have been visited by different prehistoric groups. He insists that an early- or middle-stage fluted biface can no longer be classified as Clovis based solely on its morphology, but must also take into account contextual and chronometric data. If future comparative studies of Clovis and Holocene lithic technologies reveal more similarities than we currently assume, he is confident that researchers will better understand where in the production sequence similarities end and diagnostic differences in final tool morphology emerge.

The problem is that diagnostic features of a lithic artifact may not develop until late in production. Eren likens this developmental morphology, as the flintknapper converts a stone blank into a finished artifact, to a developing embryo. "If you have a turtle,

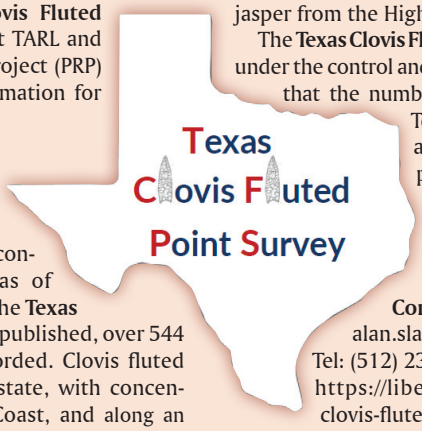
Call for Data

Alan M. Slade
Texas Archaeological Research Laboratory (TARL)
University of Texas at Austin

The author of the **Texas Clovis Fluted Point Survey** and colleagues at TARL and the Prehistory and Research Project (PRP) ask for help in updating information for the 4th edition of the **Survey**.

Brief Outline

In 1985 David Meltzer initiated a survey of Clovis fluted points in Texas. That survey continues to the present, and as of 2007, when the 3rd edition of the **Texas Clovis Fluted Point Survey** was published, over 544 Clovis fluted points were recorded. Clovis fluted points occur throughout the state, with concentrations on the High Plains, Coast, and along an arc through central Texas following the Balcones Escarpment along which high-quality chert and freshwater sources were readily available. The majority of Texas Clovis fluted points were made of Edwards chert from central Texas, with a minority fashioned of Alibates agatized dolomite and Tecovas jasper from the High Plains.



The **Texas Clovis Fluted Point Survey** has now come under the control and curation at TARL. We anticipate that the number of Clovis fluted points from Texas will be increased as well as the roll of counties where points were reported. This call for data will provide details of how and where to report any Clovis fluted-point discoveries.

Contact:
alan.slade@austin.utexas.edu
Tel: (512) 232-4898 (leave a message)
https://liberalarts.utexas.edu/tarl/texas-clovis-fluted-point-survey.php

fish, and human embryo, early on they look the same. It's not until they develop near their final form, when they've matured, that you can say that's a turtle, a fish, or human." In like manner, lithic caches are buried stone embryos that often look quite similar regardless of their time period. Projectile points may share commonalities early in the reduction sequence. For example, flute scars on a notched Holocene point disappear before tool development is complete, whereas they are maintained on the Clovis point. Thus fluting may be considered a "rudimentary organ" in the Holocene projectile point.

Lithics analysts must deal with evolving cultures

Eren believes the embryology analogy is valid because culture and technology evolve in the way Darwin understood evolution. He explains that "we know from the last 15 to 20 years of research that cultural technology evolves via Darwinian evolution." In biology, evolution is associated with genetics, but Darwin had no idea about the gene. His theory of natural selection is driven by only three agents: variation, inheritance, and sorting. If these three components are present in a nexus of phenomena or system of descent that incorporates modification, then the system is subject to evolution. Culture and technology, Eren insists, qualify as evolutionary systems.

Some examples of Eren's replicated Clovis points and a large biface.

Eren doesn't understand scholars who refuse to acknowledge that culture and technology evolve. He maintains that "people who try to say that culture doesn't evolve are like those who deny climate change. The evidence is so strong we can't deny it anymore." Culture has variation, inheritance (copying, teaching, imitation), and differential sorting (a technology is discarded for one that works better, or because a prestigious person is using a technology you copy that person). This is Darwinian evolution. To the archaeologist who insists that culture can't evolve because only things that breed evolve, Eren replies, "Well, Darwin didn't only use the word *breed*. He also said *inherit*." If we restrict the definition of evolution to the biological realm, then we reduce the scope of Darwin's genius. Once archaeologists recognize the effect of evolution in their science, Eren believes it will become easier to publish papers and become productive in the way the biological sciences have been.

On the related subject of convergence, Eren tells us we can find instances of convergence between North America and Europe, between North America and Asia. "The reason we should predict convergence is because humans are smart. All around the world we're all smart because we're all the same species." It almost appears that humans invent or stumble upon similar solutions to the same problems over and over again. "There wasn't one genius group that came up with a particular solution all by themselves. No, people have come up with solutions to the same problems independently, throughout the history of humankind. Especially with stone tools, where the number of solutions is limited by the fracture and physical constraints of that material. Therefore, given the

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limitations of stone and the inherent intelligence of all *Homo sapiens,* you're going to get convergence of stone tools all over the place in all time periods." The reality of convergence unfortunately can offend a person's sensibility. Eren regrets that "a lot of people don't seem to like the fact that Clovis isn't unique, the way they want it to be."

Being wrong can lead to right

As a flintknapper with many years of experience under his belt, Eren re-creates prehistoric stone tools in his experimental archaeology lab at Kent State. He admits his own failure to consider alternative explanations. "I make this stuff, and I was fooled by the Goodson Rockshelter. Before the dates came back I knew this was a 100% Clovis site."

He was wrong, but in science it's sometimes okay to be wrong. The goal isn't being right, Eren says, it's about making a contribution, and sometimes being wrong is the best contribution to the field as a whole. Being wrong can eventually lead to the right answer. "At Goodson," Eren remembers, "the only reason we made this discovery was because we made a mistake. We went in thinking this was a Clovis site, but it turned out to be a later period. By default, we were studying Late Archaic when we thought we were studying Clovis. Now we know that scientists need to scrupulously compare Clovis with everything that came after it."

Eren is convinced that for archaeology to mature as a science, scientists must throw away preconceived notions and go with the data. "Archaeology itself should evolve." MT

–Katy Dycus

How to contact the principal of this article:
Metin Eren
Department of Anthropology
Kent State University
e-mail: meren@kent.edu

Rolfe Mandel

continued from page 12

- How do we recognize the archaeological record of the First Americans? Does it include diagnostic artifacts? Mandel amplifies: "As I often say, we aren't sure what we're looking for, which makes the search harder."
- What were the subsistence strategies of the First Americans? How did they survive as they entered and spread across the Americas?

Spoken by a man who wears many hats

Aside from his numerous aforementioned titles, Mandel is University Distinguished Professor of Anthropology at KU. For more than 40 years he has worked with archaeologists on projects throughout the Unites States and eastern Mediterranean focusing on the effects of geologic processes on the archaeological record. In 2003 he received the GSA Rip Rap Award. His youthful pleasure of searching for fossils has taken him down a road with many twists and turns and connected him with countless individuals who guided him expertly, beginning with his parents, both scientists, who encouraged him to explore the environment.

"At my age, I try to be pragmatic about what the future holds for me," Mandel explains. "If I remain healthy, I will continue to direct the KU Odyssey Archaeological Research Program for at least several more years. My search for evidence of the First Americans will focus on buried landscapes dating to about 14,000 to 21,000 yr B.P. in stream valleys of the Great Plains and Midwest. Recently, however, I have turned my attention to the Big Bend region of southwestern Texas and the northern Yukon of Canada. Ongoing research at the San Esteban Rockshelter near Marfa, Texas, is proving to be especially promising and will continue for an indefinite amount of time."

"Rolfe is amazing," says Christopher Hill of Boise State University. "He combines a brilliance for Quaternary Studies with a global-scale perspective on service to science, and a genius for collaboration. He also cooks pretty good chili." MT

–Martha Deeringer

How to contact the principal of this article:
Rolfe Mandel
Kansas Geological Survey
University of Kansas
1930 Constant Avenue
Lawrence, KS 66047
e-mail: mandel@ku.edu

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Did Pampas megafauna survive until the Holocene?

Evidence from Campo Laborde

ALMOST 18 YEARS AGO a local farmer turned up at Universidad del Centro de la Provincia in Buenos Aires, Argentina. The farmer, Sr. Laborde, informed undergraduate student Maria Inés Rivas that he'd found a bone too large to belong to a cow or horse. When the student brought the bone from Laborde's farm to Gustavo Politis's lab for analysis, Politis, Professor of Anthropology at the university, and then–graduate student Pablo Messineo identified the bone as the femur of the ancient giant ground sloth *Megatherium americanum*.

Campo Laborde would become the only confirmed kill site of the giant ground sloth in the Americas. More important, the site would figure prominently in the debate among scientists whether the Pampas region of Argentina witnessed megafauna survival into the Holocene.

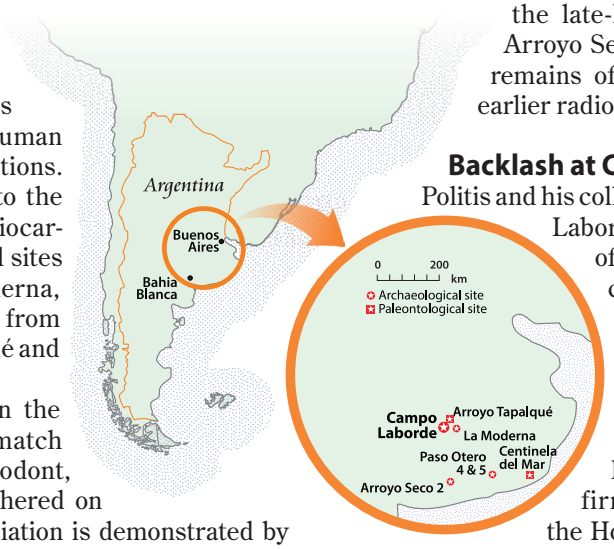
Timing megafauna extinction

Previous evidence from the Pampas region of Argentina suggested that the environment may have hosted the Holocene survival of several megamammals. Most North American archaeological sites with extinct megafauna date to the late Pleistocene (ending 11,650 yr B.P., about 10,000 RCYBP). Some sites in the Argentine Pampas, on the other hand, have been dated to the early and middle Holocene, giving archaeologists and paleontologists reason to question the impact of human hunters on late-Pleistocene extinctions. In the past, megafauna survival into the Holocene has been supported by radiocarbon dates from other archaeological sites in the Pampas, including La Moderna, Arroyo Seco 2, and Paso Otero, and from paleontological sites Arroyo Tapalqué and Rio Cuarto.

La Moderna, an open-air site on the bank of Azul Creek, is a close match for Campo Laborde. Here a glyptodont, *Doedicurus clavicaudatus,* was butchered on the edge of a swamp. Human association is demonstrated by expedient tools of crystalline quartz and curated tools of orthoquartzite and chert. Attempts to date the event yielded a conglomeration of widely varying C-14 dates. A bone sample was initially dated at 6550±160 RCYBP. A second bone sample was dated at 12,350±370 RCYBP. Other attempts at dating the event, by pretreating bone samples and by dating organic samples from the archaeological deposit, returned dates in the range of 7010±100 to 8356±65 RCYBP. If outliers were rejected, the assortment of dates suggested an age for La Moderna of 7000–7500 RCYBP.

At Arroyo Seco 2, conflicting dates obtained from megafauna remains cast suspicion on the conclusion that Pampas megamammals survived into the Holocene. The site is extraordinarily rich in the remains of extinct taxa exploited by human hunters, including two species of extinct horse, *Eutatus seguini* (a relative of the armadillo), two sloths (*Megatherium americanum* and *Glossotherium robustum*), and the camelid *Hemiauchenia* (**MT 33-3,** "Prehistory in the Southern Cone: Arroyo Seco 2"). In the late 1980s and early 1990s, bone collagen from *E.* (*Amerhippus*) *neogeus* and *M. americanum* was radiocarbon dated and yielded three radiocarbon dates (8890±90, 8470±240, and 7320±50 RCYBP), all in the early-Holocene range.

The series of Holocene-age dates was abruptly interrupted when bones of different megafauna taxa from Arroyo Seco 2 were AMS dated at different laboratories and yielded 15 ages between 12,240±110 and 10,500±90 RCYBP. Three of these new results were obtained on the *M. americanum* bone sample previously dated by the radiometric process to 7320±50 RCYBP! Likewise, *Equus* bone samples from Arroyo Seco 2 were AMS dated from ca. 12,170–11,000 RCYBP, which places them in the late-Pleistocene epoch. Consequently, Arroyo Seco 2 does not appear to harbor the remains of Holocene fauna as suggested by earlier radiocarbon dates.



Backlash at Campo Laborde

Politis and his colleagues originally excavated Campo Laborde in 2003 and submitted samples of the *M. americanum* bone for radiocarbon dating. He explains that "the results we got from the original samples at Campo Laborde indicated early- to middle-Holocene age." The radiocarbon dates thus fell in line with initial results from La Moderna and appeared to confirm that megafauna survived into the Holocene, 6900–9000 RCYBP, in open grasslands without need for refugia.

The dramatically revised AMS radiocarbon dates from Ar-

royo Seco 2 made the initial dates for Campo Laborde suspect. Politis admits that "we'd been fighting with radiocarbon dates in the Pampas for the last 20 years." When Politis and colleagues launched the second field session at Campo Laborde in 2016 and 2017, help came from geochronologist Thomas Stafford and paleontologist Emily Lindsey, armed with advanced and more accurate methods for radiocarbon-dating bone. By first purifying the collagen in the *M. americanum* bone, they derived an AMS radiocarbon date for Campo Laborde of 10,500 yr B.P. "So now we're discarding the hypothesis of the survival of megafauna," Politis tells us, "and we think they became extinct at the end of the Pleistocene. We're returning to La Moderna in 2020 to obtain new bone samples for radiocarbon dating."

Elusive chronology

The chronology of Campo Laborde and comparable sites is difficult to establish owing to extreme degradation and loss of bone organic matter and severe humate contamination of bone. The most challenging obstacle is the covalent bonding of humates (fulvic acids, humic acids, and humins) to the protein in collagen, which occurs through the Maillard reaction, a heated chemical reaction between an amino acid and a reducing sugar (the process that browns crust on bread). Only 7 of 12 bones found in the first field season at Campo Laborde had detectable collagen worth dating. Because the collagen was contaminated, these Megatherium fossils yielded radiocarbon dates in the range 6700–9700 RCYBP. Consequently, scientists interpreted Camp Laborde as an early-Holocene kill site.

Politis credits Thomas Stafford and Emily Lindsey for their work in obtaining purified collagen from bone samples. The trick to extracting the collagen is first to hydrolyze the collagen–humic acid mixture, which breaks the collagen-humate bonds, then to isolate amino acids in the collagen by passing the hydrolyzate through hydrophobic XAD-2 resin, which binds to fulvic acids and allows amino acids to pass through.

Painstaking preparation of bone samples and exquisitely sensitive AMS technology have finally given Politis and fellow scientists a clear picture of the Pampas when the grasslands were being colonized. The new radiocarbon dates reduce the interval between the arrival of humans and the extinction of megafauna in the Argentine Pampas. The dates are evidence that some extinct species like Megatherium were exploited by people, probably at a low level of predation, over at least 2 millennia before their extinction.

A megafauna kill site that was almost overlooked

On first investigating the site where the Megatherium femur was found (the 2001–03 field program), Politis first thought the Campo Laborde site was paleontological because they found pieces of bone but no lithics. After his team removed a few pieces of dark bone, co-investigator Pablo Messineo excavated a 2-by-2-m unit and lithic artifacts began to appear.

During the first field program, an area of 29 m^2 was excavated, resulting in an impressive yield of megafauna remains and lithic artifacts. In all, the team recovered 282 bones from 3 extinct megafauna taxa: *M. americanum* and two species of glyptodonts, *Neosclerocalyptus* and *Doedicurus*. Almost all the glyptodont bones were found in swamp sediments at a depth of 1–1.3 m. All the anatomical members of the Megatherium body were found. Bones of modern species were also recovered, as well as of smaller vertebrates. About 70% of the lithic artifacts were found among the bones, which positively correlated the bones and cultural evidence. The lithics recovered include the stemmed base of a broken lanceolate bifacial projectile point, a broken sidescraper, and 128 microflakes 2–9 mm long of orthoquartzite, silicified dolomite, and chert.

Messineo holding megatherium bone.

After the first field program, Politis's team were excavating other sites, but, as he remembers, "we felt the need to return to Campo Laborde to improve the accuracy of the radiocarbon dates because we had a cooperative agreement with Thomas Stafford and Emily Lindsey, who performed the advanced radiocarbon analyses."

In the second field program in 2016–17, Politis and his colleagues excavated a new area of 21 m^2 to acquire bone samples and lithic artifacts. "We were lucky," he says, "because we had found half of a sidescraper in previous excavations, and in the second field program we found the other half; the two matched." The edge of the distal half was resharpened after breaking, indicating that half the tool broken during use was reworked and used again.

Messineo holds pieces of a broken sidescraper, found 3½ m apart in two field sessions, that were refitted.

UNLESS NOTED, ALL PHOTOS: GUSTAVO POLITIS

In addition to the close vertical and horizontal association with lithics, other evidence supports the butchering and

processing of *M. americanum* at Campo Laborde. Evidence of butchering includes two bone tools fashioned from megamammal ribs, one from the right distal end of *M. americanum,* the other from the rib of an unidentified megafauna species the same size as Megatherium. Use-wear analysis interprets wear polish as the result of contact between the bone tool and a hard material. Since no other bones in the collection show evidence of abrasion or polishing, not even to a lesser degree as can happen in a swamp environment, Politis is confident the analysis supports the human manufacture of two bone tools.

JUAN MANUEL CAPUANO

Politis.

Furthermore, Messineo found three areas of cutmarks on the interior surface of a right rib of *M. americanum* at a transverse orientation to the rib axis. They are unambiguous stone-tool cutmarks perpendicular to the cortical surface, V-shaped in cross section and with internal microstriations, two of them bearing multiple parallel marks. These marks are consistent with activities related to skinning the animal.

The recent excavations and new radiocarbon dates support Politis's contention that Campo Laborde is a kill and butchering site at the edge of a late-Pleistocene swamp. The lithic materials suggest that hunters knapped directly around the carcass of the animal, and the refitting of sidescraper fragments and microflakes supports the stratigraphic integrity of the deposit.

View of the Megatherium bones at Campo Laborde. All bones are contemporaneous and formed a "living floor."

What surprises Politis and Messineo most about the site is the overwhelming quantity of Megatherium bone that was preserved and its association with the refitted sidescraper and projectile-point fragment. "The high integrity and good resolution of the site confirmed that we were witnessing the event when ancient hunters killed and butchered the animal in this place and then left," Politis summarizes. "It was a short event and well preserved. Activities at Campo Laborde were to prepare the animal for consumption, but people took the meat to other places. People left broken artifacts like sidescrapers, projectile points, and flakes (produced when they were reactivating edges during processing) behind."

Artifacts suggest a diverse lithic technology

Among the lithic artifacts recovered at Campo Laborde was a stemmed projectile-point fragment made of high-quality orthoquartzite, which outcropped about 150 km from the site. The principal projectile-point type in the region is the Fishtail point, which dates to 11,800–10,000 yr B.P. The only site in the region, however, where this point type is associated with extinct megamammals is Paso Otero 5. For Politis, the stemmed point found at Campo Laborde suggests that around 10,650 yr B.P. toolmakers created at least two styles of projectile points to hunt Pleistocene megafauna in the Argentine Pampas. The bifacial knife discovered at Campo Laborde also confirms the use of this technology in the Pampas at the end of the Pleistocene.

Looking forward

The Campo Laborde site serves as the basis for comparing other sites in the Pampas, especially in terms of finalizing the chronology across the region.

The megafauna extinctions at the end of the Pleistocene, which resulted in the loss of 35%–90% of megafauna, was the most significant faunal contraction experienced during the Cenozoic. In the New World, the causes and dynamics of the extinctions have proved especially challenging to analyze because they coincided with both end-Pleistocene climate changes and with the arrival of a new predator, *Homo sapiens.*

– Katy Dycus

How to contact the principal of this article:
Gustavo Politis
Department of Anthropology
Universidad del Centro de la Provincia
Buenos Aires, Argentina
e-mail: gpolitis@fcnym.unlp.edu.ar

Suggested Readings

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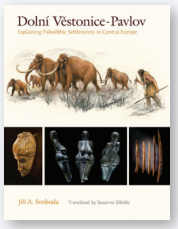

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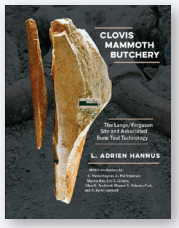

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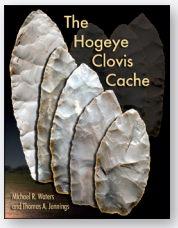

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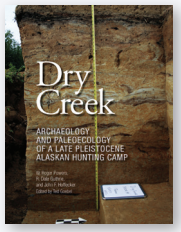

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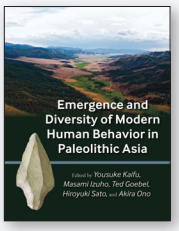

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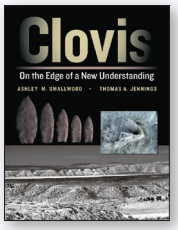

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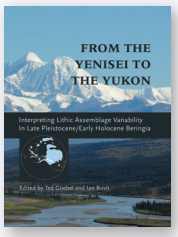

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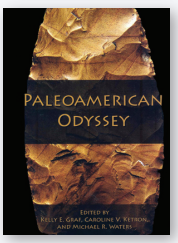

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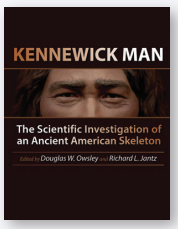

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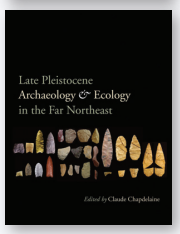

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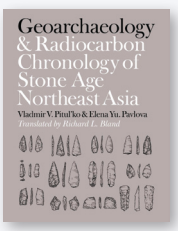

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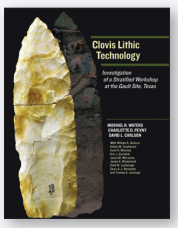

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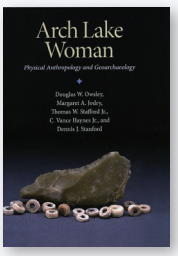

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