MAMMOTH TRUMPET

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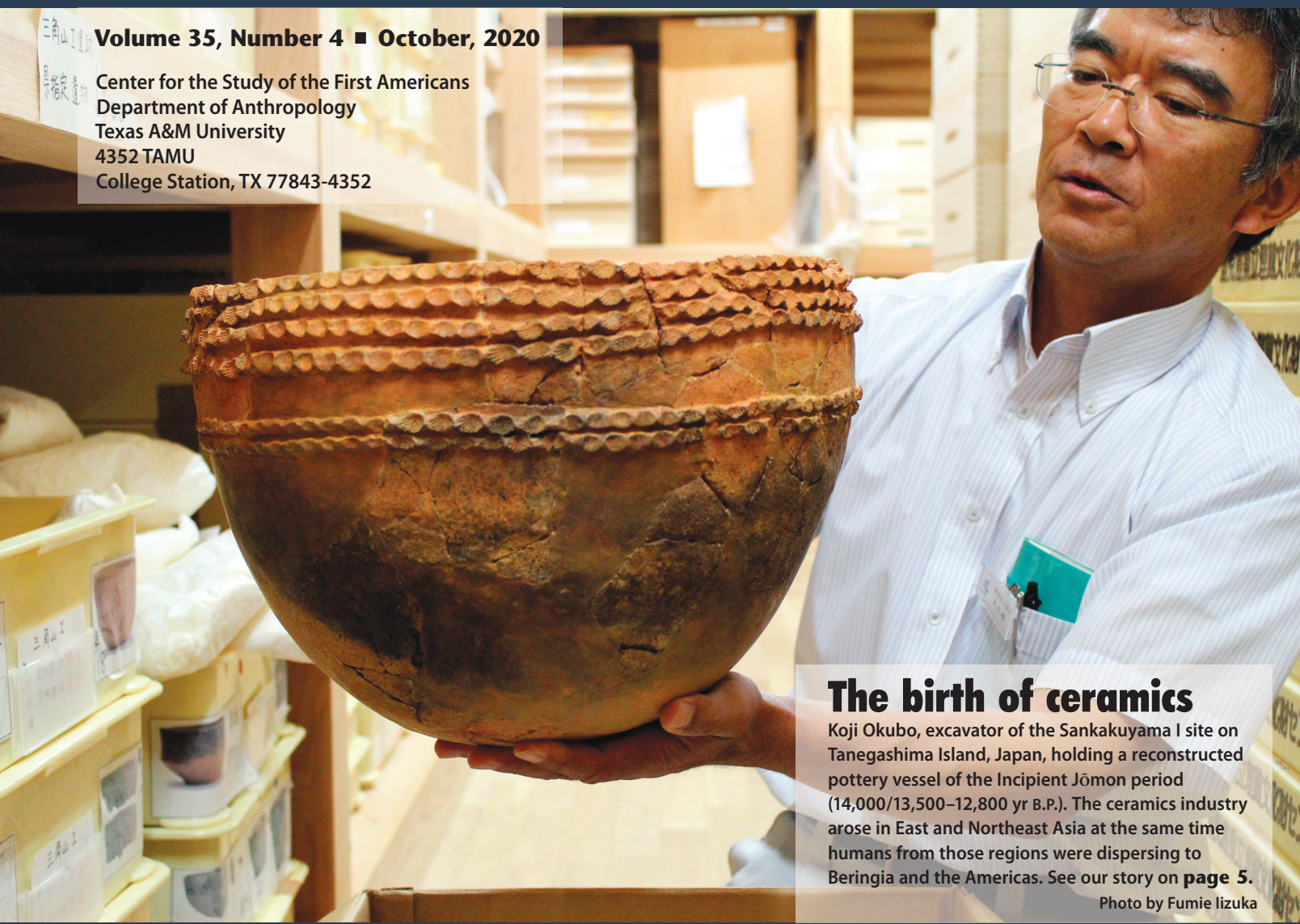

The birth of ceramics

Koji Okubo, excavator of the Sankakuyama I site on Tanegashima Island, Japan, holding a reconstructed pottery vessel of the Incipient Jōmon period (14,000/13,500–12,800 yr B.P.). The ceramics industry arose in East and Northeast Asia at the same time humans from those regions were dispersing to Beringia and the Americas. See our story on page 5.

Photo by Fumie Iizuka

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Siberian Roots of the First Americans

Excavations at the Northern Point locality of the Yana site, 2008. The cultural layer has been exposed in situ in permafrost polygons separated by ice wedges.

ELENA PAVLOVA

INSIDE

MOST SCENARIOS for the peopling of the Americas involve the ancestors of Native Americans moving out of northeastern Siberia and either walking across the Bering Land Bridge or paddling along its southern perimeter in skin boats. But who were those people? Did they originate in one region of northeastern Asia, or did several streams of migration coalesce to become the ancestors of Native Americans? A new analysis of 34 ancient genomes ranging in age from 31,000 to 600 years ago provides convincing answers to these and other questions relating to the First Americans.

To tackle such a big problem, you need a big team. For this study, Eske Willerslev of the University of Copenhagen assembled an international team of 54 researchers representing 12 different countries. They presented their conclusions in the June 5 issue of the journal *Nature* with Martin Sikora, also from the University of Copenhagen as first author, and Morten Allentoft, also with the University of Copenhagen, Vladimir Pitulko with the Russian Academy of Science, and Vitor Sousa from the University of Lisbon, Portugal, credited as equal contributors.

The Willerslev-Sikora team describe northeastern Siberia as "one of the most remote and extreme of the environments that were colonized in the Pleistocene epoch." And yet, humans were thriving in this forbidding region by at least 31,600 yr B.P. This date was obtained from the Yana Rhinoceros Horn site, or RHS, an extensive occupation site along the Yana River. The stone and bone artifacts at this site are reminiscent of what has been

found at Upper Paleolithic sites across much of northern Eurasia. Between 23,000 and 19,000 yr B.P. the people who had produced these artifacts left the region and were replaced by one dominated by a distinctive microblade technology, which appears to have originated in the Amur region of southeastern Russia. This later culture continued to spread north and east and eventually crossed the Bering Land Bridge into North America. But by the time they arrived, other people had already preceded them.

The questions the Willerslev-Sikora team sought to answer include, How were these various groups related to one another? How were they related to contemporary Siberians? And how were they related to Native Americans, whose ancestors either emerged in this region or moved through it as they drifted north and east into Beringia and eventually beyond? Since cultural similarities and differences don't necessarily correspond to biological similarities and differences, the team analyzed ancient DNA to answer these key questions.

34 Ancient Genomes

The Willerslev-Sikora team obtained whole genomes from 34 ancient individuals ranging in age from 31,600 to 600 yr B.P. These included two individuals from the Yana RHS site, which date to around 31,600 yr B.P. and thus are "the oldest Pleistocene human remains found to date at such high latitude"; one individual referred to as Kolyma 1 from the Duvanny Yar site, which was about 9,800 years old; another individual from the Yana River area, but not from Yana RHS, which dated to 800 years ago and is therefore known as "Young Yana"; 14 individuals from sites in far eastern Chukotka and the northern coast of the Sea of Okhotsk, which ranged in age from 3000 to 2000 yr B.P.; six individuals from southern Siberia, which dated from 6500 to 600 yr B.P.; and four individuals from a site in southwestern Finland, which date to around 1500 yr B.P.

Ancient North Siberians

The two ancient individuals from Yana RHS are of particular importance because they "represent the earliest direct evidence of human presence in northeastern Siberia." The population they represent is referred to as Ancient North Siberians. These people are a distinct lineage related to both early West Eurasians and early East Asians. The Yana RHS individuals are both males who belonged to the mitochondrial haplogroup U, a common lineage among ancient West Eurasian hunter-gatherers. They also both belong to the Y chromosome haplogroup P1, which is ancestral to both Native Americans and Eurasians, though the Yana RHS individuals themselves are more closely related to West Eurasians.

When the Willerslev-Sikora team compared the genome of a boy from the 24,000-year-old Mal'ta site in south central Siberia (**MT 29-2,** "Ancient Siberian boy reveals complex origins of First Americans") with those from the Yana RHS individuals, they found they were

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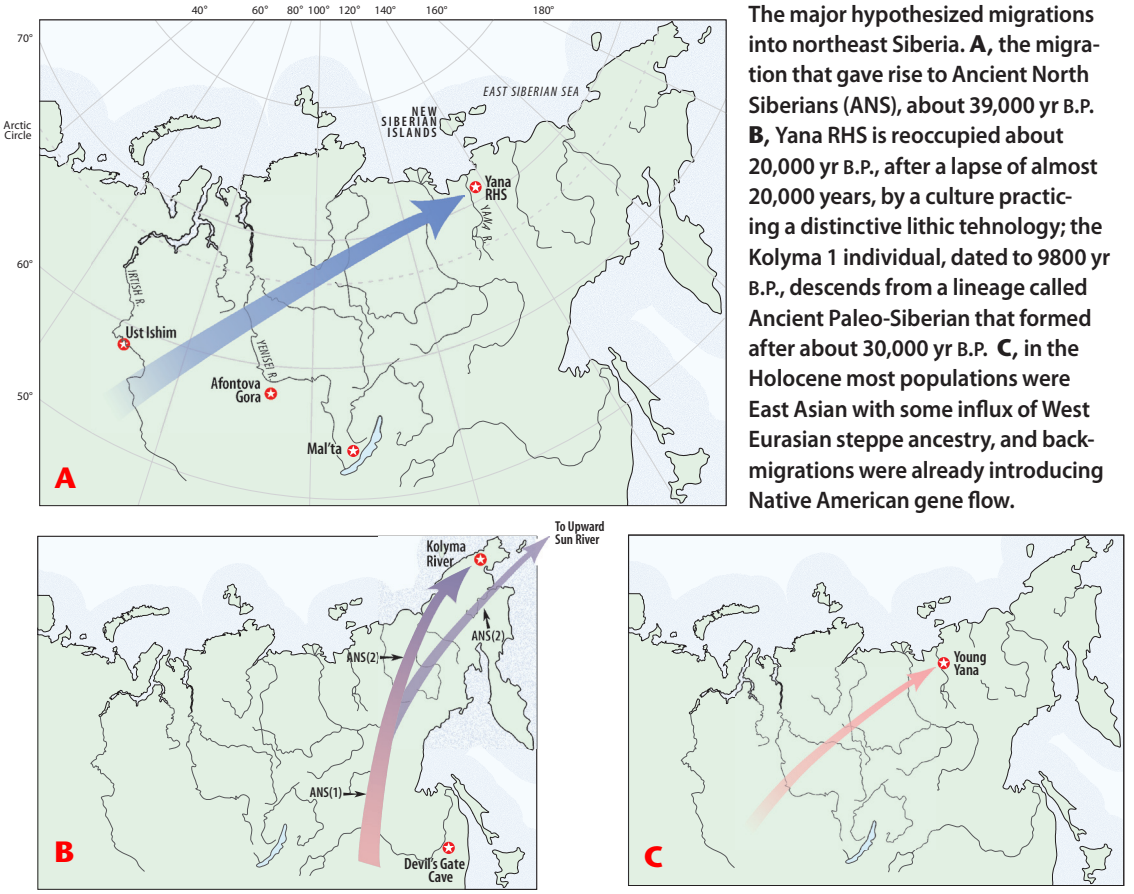
–Michael R. Waters, Director

more closely related to each other than the Mal'ta boy was to other West Eurasian hunter-gatherers. He's therefore a descendant of the Ancient North Siberians, which suggests that the Ancient North Siberians "were probably widespread across northeastern Eurasia" by 31,600 years ago.

The two Yana RHS males weren't closely related to each other and exhibited no evidence of inbreeding. Albeit this is a very small sample from which to draw broad conclusions, it nevertheless suggests that the Upper Paleolithic societies in this region had fairly well developed networks through which widespread groups could exchange mates.



ALL FROM SIKORA ET AL. NATURE VOL 570

The major hypothesized migrations into northeast Siberia. A, the migration that gave rise to Ancient North Siberians (ANS), about 39,000 yr B.P. B, Yana RHS is reoccupied about 20,000 yr B.P., after a lapse of almost 20,000 years, by a culture practicing a distinctive lithic tehnology; the Kolyma 1 individual, dated to 9800 yr B.P., descends from a lineage called Ancient Paleo-Siberian that formed after about 30,000 yr B.P. C, in the Holocene most populations were East Asian with some influx of West Eurasian steppe ancestry, and back-migrations were already introducing Native American gene flow.

Ancient Paleo-Siberians and Native Americans

After the Upper Paleolithic occupation of the Yana RHS site, northeastern Siberia evidently became uninhabitable to humans because there are no archaeological sites in the region that date to the period between it and about 20,000 years ago. This marked the end of the Last Glacial Maximum (LGM), which suggests these northern regions had been abandoned owing to the extreme cold. The Willerslev-Sikora team point out that this "gap in the archaeological sequence is critical," because it was during this period that the population that was to become ancestral to Native Americans emerged.

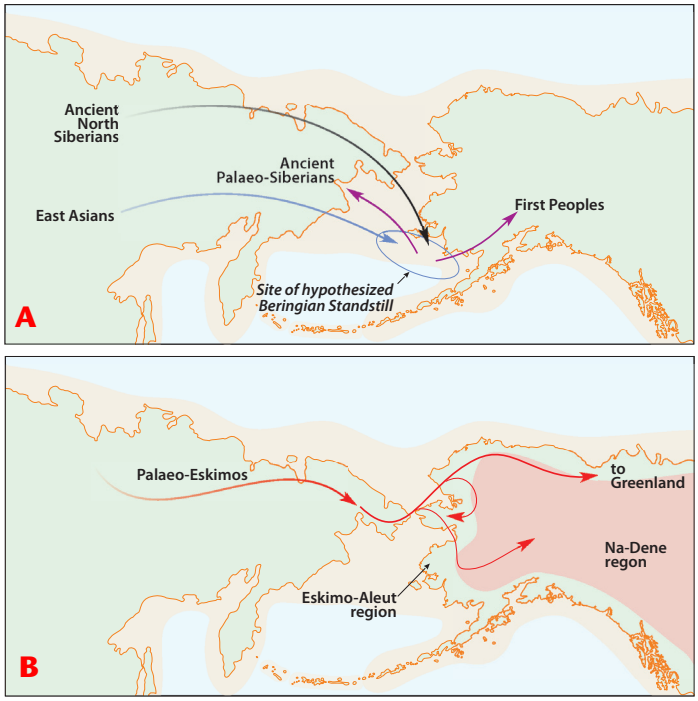
Kolyma 1, the individual from the Duvanny Yar site in eastern Siberia, is the oldest documented Ancient Paleo-Siberian. Although his lineage formed sometime after 30,000 years ago, Kolyma 1 dates to only 9800 yr B.P.. His genome reflects a mixture of Ancient Northern Siberian and East Asian ancestry similar to that found in Native Americans, although the Willerslev-Sikora team point out that the "East Asian contribution in Kolyma 1 is greater than in Native Americans."

ELENA PAVLOVA

Archaeologist Alla Mashezerskaya mapping artifacts in the area of the Yana site where a human tooth was found. Altogether three human teeth were found at Yana. One tooth yielded a sample of ancient DNA that was used by the Willerslev-Sikora team in analyzing the lineage of Ancient North Siberians.

Modeling population histories

The Willerslev-Sikora team have developed population history models that include the Han East Asians, the Paleo-Siberian Kolyma 1 individual, and Native Americans, represented by the Ancient Beringian genome of Upward Sun River 1 (**MT 34-2,** "Beringian child's genome reveals the founding population of the First Americans") and by the present-day Karitiana of Brazil. Based on these data, they determined that the ancestors of Native Americans diverged from present-day East Asians around 30,000 years ago. Then, 24,000 years ago, this population split into two groups: the ancestors of Ancient



BOTH FROM STONE, *NATURE* VOL 570

The two pulses of migration to the New World. A, during the Last Glacial Maximum, extreme cold probably impelled Ancient North Siberians to leave Siberia in search of easier conditions. This group, as a result of being sequestered for thousands of years by ice sheets, acquired the genetic signature of Native Americans. Most dispersed across the Americas either on foot or in boats, and some back-migrated to Asia as Ancient Paleo-Siberians about 24,000 yr B.P. B, DNA analysis identifies ancient Siberians, who migrated from Siberia to the Americas and Greenland about 5000 yr B.P., as the ancestors of Paleo-Eskimos. Paleo-Eskimos, in turn, are ancestral to modern Na-Dene-speaking people and to Eskimo-Aleut speakers.

Paleo-Siberians; and the population that would give rise to both the Ancient Beringians and Native Americans. Shortly thereafter, 20,000 to 18,000 years ago, descendants of the Ancient Northern Siberians moved southward, encountered these two populations, and exchanged genes with them, which led to the formation of Ancient Paleo-Siberians, who would go on to populate Siberia, and to the Native American lineage, which would give rise to Ancient Beringians and Native Americans. Around 4,000 years later, in what the Willerslev-Sikora team conclude were independent pulses, both the Ancient Paleo-Siberians and the Ancient Beringians appear to have exchanged genes with the ancestors of Ancient North Siberians. They conclude that Kolyma 1 "represents the closest relative to the ancestral Native American population in northeastern Siberia that has been found to date."

The role of climate in shaping population histories

The story of the first Americans is intimately connected to the extreme climate changes of the late Pleistocene, which ranged from the crazy cold temperatures of the LGM to the more temperate climate of the Holocene. These climate changes are often invoked to explain population movements and the abandoning of regions made uninhabitable by either the presence of giant ice sheets or the unrelentingly bitter cold.

As part of their analysis of the population history of northeastern Siberia, the Willerslev-Sikora team modeled the climate for this region to determine which regions were habitable between 48,000 and 12,000 years ago. They found that humans were able to live in northern Siberia at the Yana RHS site 31,600 years ago, because it was a relatively brief warm period within the Pleistocene Epoch. Once the cold returned, the humans generally were forced to retreat southward. The climate models indicate, however, that even during the LGM, a refugium of moderate climate existed across southern Beringia. The Willerslev-Sikora team propose a possible scenario to account for the emergence of both Native Americans and Ancient Paleo-Siberians from early Ancient North Siberians inhabiting the southern Beringian refugium.

As the climate warmed towards the end of the LGM, East Asian–related peoples moved north along the coast of Beringia and encountered and subsequently merged with resident Ancient North Siberian groups in eastern Beringia. The Willerslev-Sikora team observed that this scenario would be consistent with the genetic data, which suggest that Ancient Beringians diverged from ancestral Native Americans in eastern Beringia.

An alternative scenario has these populations meeting and merging in the Lake Baikal region of southern Siberia and expanding northward as the climate warmed following the LGM. This scenario is supported by the closer affinity of both Kolyma 1 and Native Americans to the Mal'ta individual as well as by archaeological evidence.

One problem with this scenario, however, is that the genetic data indicate that Asians and the ancestral Native Americans were isolated from one another after about 23,000 years ago. For the Ancient Paleo-Siberians and ancestral Native Americans to have remained genetically isolated, they must have been physically isolated in separate refugia for at least 5,000 years.

Regardless of which of these scenarios is ultimately supported by future archaeological and genetic research, the results obtained by the Willerslev-Sikora team demonstrate that "glacial and post-glacial climate change was a major driver of human population history across northern Eurasia."

Arizona State scholar Anne C. Stone, with the School of Human Evolution and Social Change, applauds the work of the Willerslev-Sikora team . . . and she reminds us that pieces of the puzzle we call the Peopling of the Americas are still missing:

> In the ongoing debate about how many 'waves' of migration led to the establishment of human populations in the Americas, the new papers could be interpreted as suggesting that there were just two: the First Peoples and the Paleo-Eskimo peoples. If so, then how does this tally with the idea that some Amazonian populations seem to share DNA13,14 with people who speak Austronesian languages (who live today in southeast Asia, Oceania and Madagascar)? Did the populations in the Beringian refugium also have this ancestry?

continued on page 14

CERAMICS

Born in Pleistocene Asia, the industry hitched a ride to the Americas

Part 1

THE ART OF MAKING POTTERY VESSELS, among the most intriguing artifacts in archaeology, has traditionally been viewed as a material correlate of the Neolithic age, which was triggered by climate change at the end of the Pleistocene in places like the Middle East, Northeastern Africa, and Europe.

The shift, otherwise known as the Neolithic Revolution, invoked a dramatic change in lifestyle from small nomadic forager groups to people managing their environment with new technologies and behaviors. Animal domestication followed plant cultivation and the appearance of pottery, groundstone, food storage, and weaving, all of which fostered a population increase resulting in sedentary communities. Ceramics served a variety of utilitarian purposes, especially vessels for preparing and storing heated food and capable of holding large volumes of liquid.

The Neolithization of Northern Eurasia is marked by the emergence of pottery among hunter-gatherer societies. Although the driving forces behind the adoption of ceramic vessels among non-agricultural societies remain unclear, research out of Northeast Asia suggests that it was adopted as a specialist technology for processing aquatic resources, tied to the expansion of fishing activities and a move to sedentism.

Researchers studying the origins of rice domestication in South China suggest that the process began around the onset of Holocene. Radiocarbon dates place pottery at 20,000–17,000 yr B.P., which is thus interpreted to be hunter-gatherer technology. At some major sites, however, pots are associated with partially domesticated rice. Thus in South China the time discrepancy on possible dates is very large, up to 10,000 years. Those who accept the radiocarbon dates study pottery as hunter-gatherer technology. Scholars interested in domesticates look at the pottery together with rice domesticates. On the other hand, the picture is quite different in Japan and Siberia.

Fumie Iizuka, a project scientist affiliated with the Department of Anthropology and Heritage Studies at the University of California, Merced, researches ancient pottery production in East and Northeast Asia. Her current focus is on the southern Kyushu region of Japan, particularly its intraregional variability. Ceramics technology was developed by hunter-gatherers with varying degrees of mobility. In southern Kyushu, Iizuka tells us, "when ceramics were adopted substantially by foragers around 14,000–13,500 yr B.P., there are signatures of increased sedentism." But pottery is found at low intensity before this period. This earlier pottery and the level of residential mobility is unclear.

For Iizuka, this origin is significant because pottery was adopted in East and Northeast Asia around the same time humans from the same regions were dispersing to Beringia and the Americas. This simultaneity of events figures prominently in Iizuka's investigations.

Who were the earliest pottery producers?

Let's journey back in time. The earliest ceramic evidence is ceramic pellets and figurines from Gravettian contexts of the Upper Paleolithic in Europe 32,000–27,000 years ago. Scholars assume that these early ceramics were used for symbolic activities by foragers with low residential mobility. "In the Near East," according to Iizuka, "pottery vessels appeared around 10,000–9000 years ago, developing out of clay-lime and gypsum-plaster pyrotechnology." In Northern Africa, pottery first appeared at the Pleistocene-Holocene transition among foragers; these early ceramics may have been used to cook newly available plants or aquatic resources. Across central Europe, pottery dated to 7400–6900 yr B.P. was used by farming communities, possibly to store, transport, and prepare food.

MASAMI IZUHO

Fumie Iizuka collecting raw material for pottery sourcing on Tanegashima Island, Japan.

The earliest pottery vessels in the world, however, appeared in East and Northeast Asia as early as the late Pleistocene:

- South China, 20,000–17,000 yr B.P.;
- North China, around 11,500 yr B.P.;
- Japanese Archipelago, 17,000–15,000 yr B.P.;
- Russian Far East, 16,000–14,000 yr B.P.;
- Transbaikal region of Siberia, 14,000–12,900 yr B.P.

Iizuka cautions us that these dates for the appearance of Asian ceramics and their behavioral contexts have been debated and

that early pottery from these regions requires critical examination by site and area.

Obtaining a solid chronology is difficult for several reasons. In South China, for instance, difficult environmental and depositional contexts have yielded possibly inaccurate older dates. Iikuza notes a discrepancy of 10,000 years in the geochronology of South China: Some objects dated to 20,000–17,000 years ago possibly date to 10,000 years ago. In studies of South China, the difficulty in establishing geochronology comes mainly from associated phytoliths of partially domesticated rice or macrobotanical remains. A further complication is the absence of lithic technological changes, which makes it hard to identify timing of changes. As Iizuka points out, "If ceramics appeared along with lithic technological changes, it would make it easier to pinpoint behavioral changes." Unfortunately, the stone tools "don't seem to be similar to what we see at early sites being discussed by First Americans scholars."

In the Transbaikal region, an assumed age based on stratigraphic observation may differ drastically from a calibrated radiocarbon date. Compressed stratigraphy in the Amur River basin complicates dating closely spaced artifacts. In the Korean Peninsula, pottery appears to have been adopted later, for reasons that require further investigating. A host of problems arises when analyzing data from old excavations that lack precise stratigraphic detail or detailed reports. Moreover, Pleistocene sites with associated ceramics suffer from neglect in the archaeological record.

Moving into the New World

In North America, the Clovis culture dates to 13,200–12,900 yr B.P. Its end coincided with the onset of the Younger Dryas and the extinction of megafauna. Clovis sites are normally associated with megafauna, but in pre-Clovis sites the association is less clear. Combined genetic, paleoenvironmental, and archaeological data suggest that humans first arrived in the Americas around 15,000 yr B.P. through the coastal route by boat, which may coincide with the dispersal of microblade producers in Northern Siberia and Beringia, the ancestors of Clovis toolmakers. A second wave of ancestors of Clovis toolmakers may have migrated by way of the Ice-Free Corridor around 13,600–13,500 yr B.P.

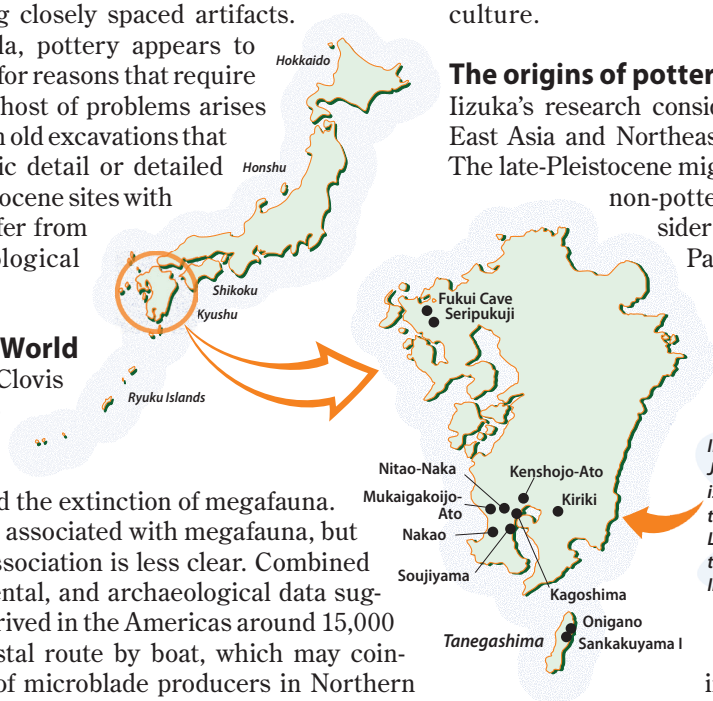
Recent genetic studies show that Asian ancestors and the forebears of Native Americans diverged 23,000–20,000 yr B.P.; gene flow from Northern Eurasians, however, may have continued as late as 20,000–18,100 yr B.P. Iizuka cites genomic and archaeological evidence that traces the forebears of Native Americans to the region between Lake Baikal and the Japanese Archipelago. Those forebears, according to the Beringian Standstill Hypothesis, became isolated by 23,000–18,000 yr B.P., when the genetic signature of Native Americans developed. After the standstill, populations migrated southward and populated the Americas by 14,000–15,000 yr B.P. The forebears of First Americans, therefore, must have originated somewhere in greater East Asia, with a minor contribution from central Siberia.

Pottery as evidence for or against migration

In determining whether a region of Asia is a likely candidate for the origin of the proto-Beringians, Iizuka considers whether the region had developed pottery by the time of the Beringian Standstill. This is crucial because pottery didn't appear in the New World until about 8000–5800 yr B.P.; authorities debate about early sites in Brazil and Colombia. In North America, among the first pottery to appear is the Stallings Pottery tradition in the Savannah River valley, about 4500–3500 yr B.P. (**MT 26-1,** "The ceramic gap"). Iizuka reasons that if Beringians already possessed pottery, the technology would have appeared in North America by the time of the Clovis culture.

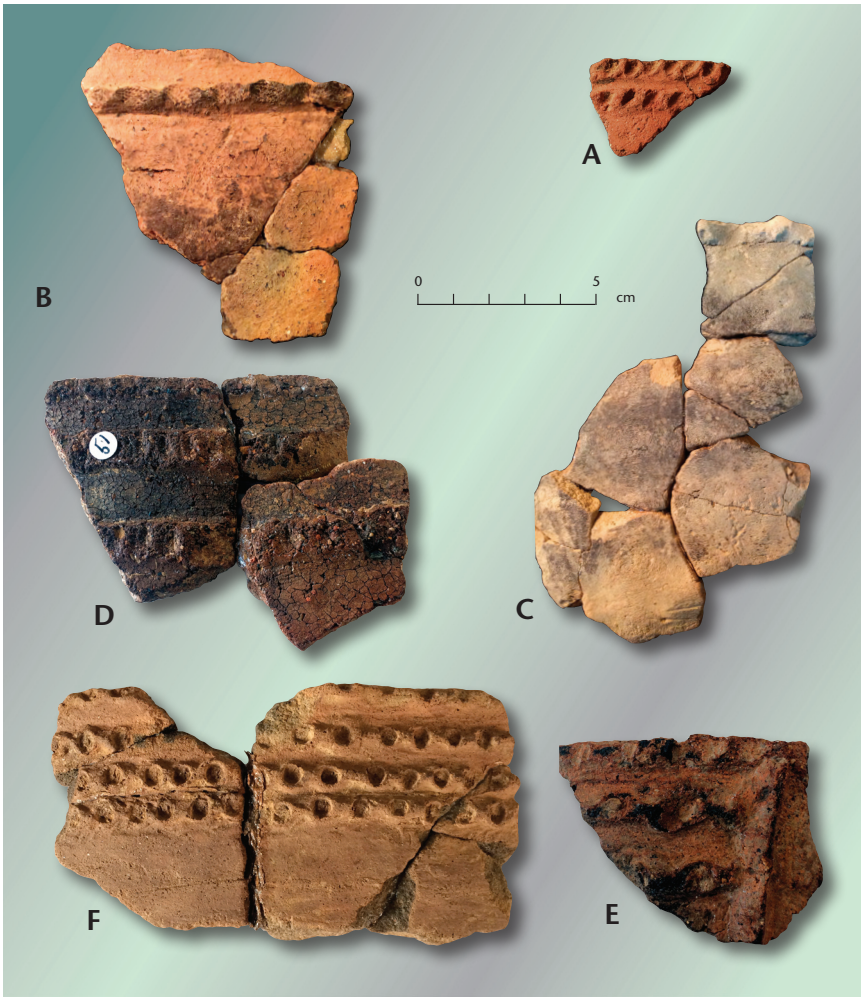
The origins of pottery in East and Northeast Asia

Iizuka's research considers the origins of pottery in greater East Asia and Northeast Asia relative to two major contexts: The late-Pleistocene migration of humans to the Americas; and non-pottery technologies archaeologists consider when tracking the migrations of Upper Paleolithic people.



In Southern Kyushu, Japan, Fumie Iizuka is studying the transition from the Late Upper Paleolithic to the Incipient and Initial Jōmon

In South China, the dominant lithic technology from the LGM to the early Holocene was the cobble-tool industry. For subsistence, foragers collected wild rice in the Yangtze Valley in the late Pleistocene; rice was first cultivated in the early Holocene 10,000 years ago. Coincident with the domestication of rice, the first pottery vessels appeared in South China during the preboreal to early boreal periods—that is, Iizuka cautions, "if we take the



FUMIE IIZUKA

Examples of pottery from the Incipient Jōmon. A–C, from the Sankakuyama I site, Tanegashima Island, Japan, now curated in the Kagoshima Prefecture Center for Buried Cultural Property; D–E, from the Nakao site, the mainland Kagoshima, now curated in the Kagoshima Prefecture Center for Buried Cultural Property, F, from the Onigano site, Tanegashima Island, Japan, now curated in the Nishinoomote City Board of Education.

evidence of associated micro- and macrobotanical remains, not radiocarbon dates." (The preboreal transitional phase, 10,300–9000 yr B.P., immediately followed the Younger Dryas and was succeeded by the boreal, 9000–7500 yr B.P.) During this time, people were transitioning from mobile to more sedentary lifestyles. Their diet evolved to include small to mid-size wild fauna, wild and partially domesticated rice, and some fish and shellfish. Iizuka finds that the subsistence and mobility patterns of South China early pottery users don't match those of the First Americans. Moreover, these people weren't adapted to the sea coast and didn't hunt megafauna and consequently depart even further from the behavior of the First Americans.

In North China, the Late Upper Paleolithic is dominated by microblade industries. Pottery emerged at the Pleistocene-Holocene transition, about 13,000–10,700 yr B.P., during a transition in subsistence to agriculture. The lifestyle was increasingly sedentary. Foraging activities required some mobility, but not on the scale of Beringian big-game hunter-gatherers. If the forebears of the First Americans came from North China, they would have had to migrate a millennium before pottery technology emerged. North China can't be a candidate for the source of the First Americans, says Iizuka, because "the timing is too late."

In Siberia, the Late Upper Paleolithic hunter-gatherers who made microblades began to resettle the Siberian steppe after the LGM, when climate extremes diminished. They expanded into far Northeast Asia, reaching the arctic coastal plain. These individuals belonged to small, highly mobile groups with efficient hunting skills directed toward a few mammal species. At some late-Pleistocene sites, ceramics are found in association with microblades and microblade cores in the Amur River basin of the Russian Far East and in the Transbaikal.

The earliest evidence for pottery in the Russian Far East dates to the terminal Oldest Dryas (OD), about 16,000–15,600 yr B.P. Mixed archaeological signatures are found indicating both high mobility (blades and bifaces) and reduced mobility (semi-subterranean dwelling and net sinkers). Iizuka notes that notoriously ill-defined stratigraphy at sites in the Russian Far East makes it difficult to determine whether artifacts date to the OD or to the Bølling-Allerød (B/At) period (14,700–12,700 yr B.P.). If decreasing mobility predominated by the OD, then pottery users from the Russian Far East may have already adopted a sedentary lifestyle, which would militate against their migrating. In other words, if the peopling of the Americas began in the Rus-

FUMIE IIZUKA

Obsidian outcrop with hand-held magnifier (*arrow*) for scale, Shirahama, Kumamoto Prefecture, Japan.

sian Far East region, current evidence implies that this event had to have happened before 16,000 yr B.P.

In the Transbaikal, high mobility is associated with the first pottery producers, but no ceramics were produced before the B/A. Pottery makers from Transbaikal were too late to be among the first migrants to Beringia before 15,000 yr B.P. If we accept the evidence of the 13,800 yr B.P. period for the appearance of pots in the Transbaikal, says Iizuka, "it's prior to the Clovis period, so we have to leave open the possibility of some contribution of pottery producers to the peopling of the Americas. Highly mobile people in Transbaikal would agree with the First Americans' lifestyle." Confirming the timing of the introduction of pottery, coupled with genetic and paleoenvironmental evidence, will determine whether people during this period of pottery production contributed to human migration to the New World.

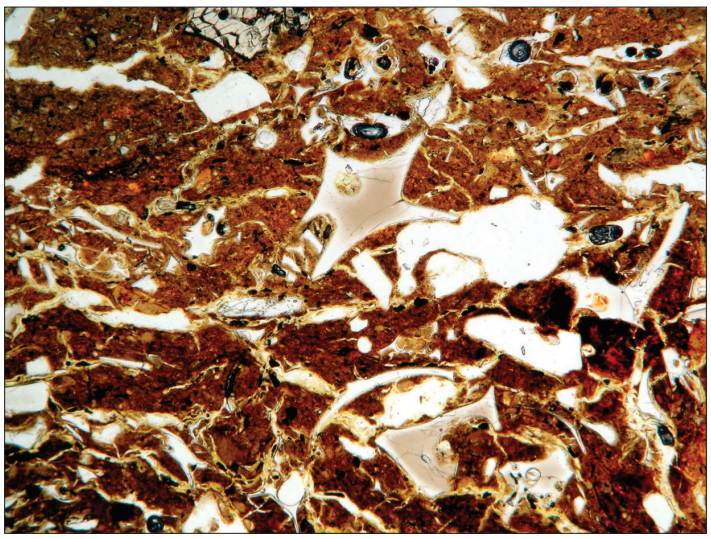
FUMIE IIZUKA

Sourcing obsidian used by Upper Paleolithic and Incipient Jōmon toolmakers, Gomeki, Kagoshima Prefecture.

Based on the current evidence, Iizuka believes we can confidently trace the origins of the source populations of the First Americans to Japan and the Transbaikal (exercising caution with the dates of the first pottery of the Transbaikal, where stratigraphic contexts suggest a date of ca. 7000–6000 CALYBP, during the Atlantic Optimum).

From Japan to Beringia

In the Japanese Archipelago, the earliest ceramics may have appeared 16,500–15,300 yr B.P. during the mid to late OD in Paleo-Honshu (and possibly -Kyushu). Pottery was certainly adopted by 15,300 yr B.P., when we see the emergence of distinctive pottery technologies. The timing tells us that a dispersal out of Japan to Beringia had to have occurred before this time.



FUMIE IIZUKA

Viewed in plain polarized light, thin section of pottery with volcanic glass dating to the Incipient Jōmon, from Sankakuyama I site, Tanegashima Island, Japan.

Iizuka's initial interest in pottery production began in Latin America. Panama had a good geological context for the work she wanted to do; its oldest sites date to the mid Holocene. She first became interested in Japan in 2014, when she investigated southern Kyushu in her research on the origins of pottery during the late Pleistocene. Then she learned that the densest concentration of early pottery sites is found in Japan. "There are sometimes 100 times more sites," she tells us. "Japan has a governmental system in place so municipalities have the Cultural Resource Management resources to dig sites. Every time a construction site encounters cultural heritage, they start to dig. There are over 2,000 sites now reported in Japan." In fact, her greatest challenge was the sheer quantity of sites. "I wanted to extract representative sites from late-Pleistocene Japan that would exhibit variability and the archaeological problems and what we can define and what we don't know yet. Selecting those few sites from a total of 2,000 was hard. I went back and forth and selected and discarded."

Because Iizuka's native language is Japanese, it's easier for her to find the details on sites in Japan than in other parts of East Asia. Sometimes information is lost in translation if her project crosses national boundaries. She's sure that "if we communicate better, we'll find more sites. And maybe there are 10 times more sites in Russia or China, but just small fragments of pots that haven't been reported in English-language literature. We don't know."

Japan's first pottery producers could have been the source population for the Beringians and First Americans, Iizuka says. After all, in both Paleo-Honshu and -Kyushu, early pottery producers were highly mobile foragers, although none of the early users across the Japanese Archipelago hunted megafauna. In fact, the woolly mammoth and associated species were gone from Paleo-Hokkaido through extinction or northward migration when warm, but still cold, conditions emerged by the beginning of the OD.

If pottery producers migrated north from Paleo-Honshu during the mid to late OD via the coast or overland, it likely wasn't owing to the disappearance of megafauna. Nor is there convincing evidence from Honshu and Kyushu that pottery users from the OD were consumers of marine resources, coastally

adapted, or skillful navigators of the sea. Among the few exceptions to this pattern is the circulation of obsidian discovered between the small island of Kozushima and the Pacific side of mainland central Honshu from the Upper Paleolithic to the Middle Jōmon period.

If the coast was used for migration to the Americas, there's little evidence from Japan to support this. The main problem, according to Iizuka, is that no pottery has been recorded in the Americas in a Pleistocene context. This may be owing to a low visibility of pottery vessels, or they may not have been produced in large quantity and most likely not fired at high temperatures. Freeze-thaw cycles in northern environments during the Pleistocene may have destroyed early ceramics as well.

Another, more compelling possibility is that mobile foragers from Honshu and Kyushu may have abandoned ceramics in their northward migration. Traveling to Beringia, they would have encountered large fauna as well as other unfamiliar resources. Pottery users may therefore have changed their technological and subsistence habits by the time they reached the Americas.

FUMIE IIZUKA

Petrographic thin section of clayey soil in cross-polarized light with granitic inclusions, Yakushima Island, Japan.

The rise in sea level around the chain of islands in the Japanese Archipelago and the change in human behavior during the B/A should be examined region by region, according to Iizuka. Regarding coastal adaptation, there's possible evidence of inter-island navigation about 14,000–13,500 yr B.P. on Tanegashima. But the population was hunter-gatherers, increasingly sedentary and adapted to warmer conditions than, for example, people from Hokkaido. Rapid migration to the Americas by land or sea wouldn't be expected from such a population. MT

–Katy Dycus

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Suggested Readings

Davis, L., et al. 2019 Late Upper Paleolithic occupation at Cooper's Ferry, Idaho, USA, ~16,000 years ago. *Science* 365:891–97.

Iizuka, F. 2018 The timing and behavioral context of the late Pleistocene adoption of ceramics in Greater East and Northeast Asia and the first people (without pottery) in the Americas. *PaleoAmerica* 4:267–324.

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.

Overview of the Cooper's Ferry canyon landscape.

An important addition to pre-Clovis sites

COOPER'S FERRY

THE COLUMBIA RIVER ranks as one of the great rivers of the world. From its headwaters in British Columbia, the river courses through rocky canyons and finally empties into the Pacific Ocean near Astoria, Oregon. The enormous volume of water, most of it from snow-pack melts in spring and early summer, is also an ideal environment for cold-water fish like salmon and steelhead.

For First Americans, the mighty Columbia River and its tributaries became an off-ramp from coastal migrations and the first viable route to the vast interior of North America south of the ice sheets.

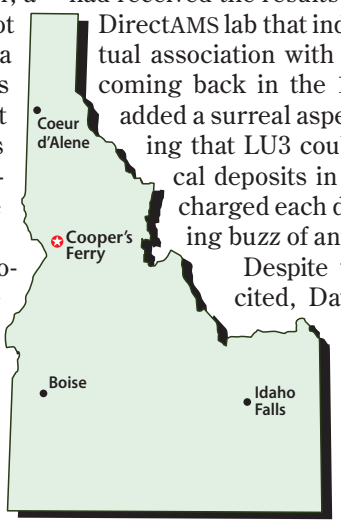
A long gestation period for success

In a canyon in Idaho near a bend in the lower Salmon River, a tributary of the Columbia, Cooper's Ferry is an idyllic spot with hot summers and cold winters. It was once the site of a Niimíipuu (Nez Perce) village called Nipéhe. Today Cooper's Ferry is managed by the U.S. Bureau of Land Management (BLM) Cottonwood Field Office. Archaeologist Loren Davis of Oregon State University first began excavating at Cooper's Ferry in the '90s as part of his doctoral studies at the University of Alberta.

"The process of discovering the earliest record at the Cooper's Ferry site wasn't an *aha!* moment but gradually came into focus over a period of many years," Davis says frankly. In 1997, as part of his doctoral research, Davis excavated a 2-m-by-2-m unit that uncovered the oldest archaeological layer at Cooper's Ferry, Lithostratigraphic Unit 3 (LU3). "At that time, we uncovered a pit feature containing a cache of Western Stemmed Tradition tools in association with charcoal that returned radiocarbon ages of 13,250 CALYBP. These early ages were essentially associated with the surface of LU3, possibly providing timing for the end of LU3 deposition," Davis says.

From 2009 to 2018, Davis led 8-week summer field seasons. "I was eager to learn more about the antiquity of LU3 and to know if there was an archaeological component that was buried within this deposit, representing even earlier occupation," Davis says. These excavations focused on two blocks, area A, measuring 7m by 13m, and area B, 12m by 12m (**MT 31-3,** "The dirt on Cooper's Ferry"). Always beckoning him was the hope of discovering that the tools he had found in the '90s predated Clovis.

Over the final two summers, Davis's team of students and researchers reached the lower layers of the site, which contained some of the oldest artifacts. They found heat-cracked rocks from ancient campfires, workspaces for making and repairing tools, butchering sites, and fragments of animal bone. Davis remembers that "at the start of the 2018 field season, I had received the results of a few radiocarbon results from the DirectAMS lab that indicated charcoal found in good contextual association with artifacts buried deeper in LU3 were coming back in the 14,000-year-old range. These results added a surreal aspect to our last field season—just thinking that LU3 could be one of the earliest archaeological deposits in North America was electrifying and charged each day of our excavations with an underlying buzz of anticipation."



Despite the excitement these early dates incited, Davis remained skeptical; to establish that people were present at Cooper's Ferry this early on, he needed more than a few AMS dates. In the fall and winter of 2018, Davis worked from his laboratory at OSU to select bone and charcoal samples to send to Lorena Bercerra-Valdivia and Tom Higham at the Oxford Radiocarbon Unit. "As the result of many Oxford AMS ages that came in from December 2018 to February 2019, the radiocarbon ages for LU3 not only validated the 13,000- to 14,000-year-old numbers we had already seen, but many

analyses returned ages in excess of 15,000 calibrated years," he recalls. "My skepticism was replaced by a realization that the archaeological record of LU3 was much earlier than we had initially realized."

More precisely, through a combination of Bayesian age modeling and archaeological evidence from LU3, Davis and his team have shown that humans were initially present at the Cooper's Ferry site 16,560–15,280 CALYBP.

Growing number of pre-Clovis sites in the Americas

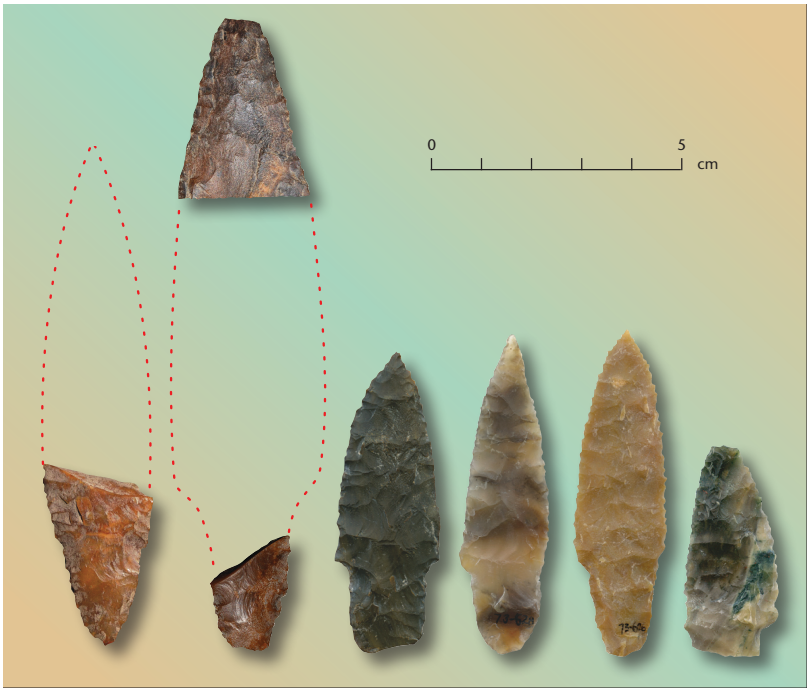
In recent years, the Clovis-First model has been overturned by increasing evidence from early sites in the Americas that humans were already present here before the formation of the Ice-Free Corridor (IFC) about 13,000–14,000 years ago. And this evidence supports a number of contemporaneous and older cultural manifestations at least 2,000 years before the appearance of Clovis. This includes the Western Stemmed Tradition, Beringian assemblages, and Eastern Seaboard sites in North America alongside the El Jobo/Monte Verde and fishtail bifacial technologies and edge-trimmed traditions in South America.

The Monte Verde site at the southern tip of Chile is about 14,500 years old, the Friedkin and Gault sites in Texas are 15,500 and 16,000 years old, respectively, and the Paisley Caves in Oregon date to about 14,000 years ago. The only rival to Cooper's Ferry as the oldest site in North America is the Gault site in Texas, which researchers OSL-dated to 16,000 yr B.P. Cooper's Ferry can now be added with confidence to this growing number of pre-Clovis sites in the Americas. Davis's conclusion: "Humans were present south of the North American continental glaciers more than 1,000 years before the earliest hypothesized timing of when the Cordilleran and Laurentide ice sheets may have separated and became ecologically viable, so we can deduce that people must have initially migrated southward into the Americas along a Pacific coastal route."

Analysis of DNA extracted from bison remains from the northern to the southern end of the IFC show that the corridor wasn't habitable until 13,100 years ago—too late to explain the pre-Clovis archaeological sites. Cooper's Ferry is one of several sites that negate the IFC hypothesis and confirm that humans initially migrated into the Americas along the Pacific coast. Davis admits that his discovery doesn't preclude later human migrations through the IFC, as suggested by paleo-genomics. But such possible population movements, he insists, weren't part of the *initial* peopling of the Americas.

Cooper's Ferry site Area A excavations at work, 2018.

"As late-Wisconsian deglaciation progressed even further, people could have eventually moved from the higher-latitude areas of North America to areas south of the ice sheets (or vice versa) through an Ice-Free Corridor, but not initially," Davis explains. "Given that the earliest evidence from Cooper's Ferry predates initial human presence in eastern Beringia, it seems more likely that the first movements of people from northeastern Asia were along the northern Pacific rim and not through the interior. As humans moved along the Pacific coastal margin, they probably gradually penetrated inland at different points to settle down while other groups continued their movements south."t



Earliest stemmed points from the Cooper's Ferry site.

The Northeast Asia connection

The cache of Western Stemmed points discovered at Cooper's Ferry, among the oldest found in the Americas, are evidence that this lithic technology developed before Clovis. Spear points belonging to the Western Stemmed Tradition are smaller and lighter than hefty Clovis points and have been recovered at early sites from British Columbia to Peru, and as far inland as Texas. Furthermore, stemmed projectile points appear throughout Africa, the Levant, and Europe as early as 50,000 years ago, Davis reports in his recent study in *Science*.

The technology recovered in LU3 at Cooper's Ferry resembles Upper Paleolithic projectile points found in sites on Hokkaido, the northernmost island of the

Japanese Archipelago, on the basis of observed similarities in 3-D morphometry and modes of lithic technology. "The Japanese stemmed-projectile-point tradition predates the peopling of the Americas by thousands of years," Davis tell us, "and, given its geographic location on the northern Pacific rim, may have been a source for some of the technological knowledge that accompanied initial human migrants that entered North America. The early peoples of Japan also possessed knowledge about deep-sea fishing with shell hooks and about manufacturing ceramics. While these traditional technologies could have been independently invented by the peoples of the Americas, it isn't unreasonable to ask questions about whether such technological similarities might actually represent the transmission of cultural knowledge among late-Pleistocene foragers" (**MT 34-3,** "Hooked on Cedros Island: An oasis for prehistoric fishermen").

In Japan and Korea, Hakuhen Sentoki projectile points dating from 30,000 to 23,000 yr B.P. were made by retouching the proximal end of a thick, pointed blade. The bifacial stemmed-point type, seen mainly in Japan 16,000–13,000 yr B.P., was made on macroflakes or blades with contracting bases and elaborate bifacial retouch. Regional variants include the Tachikawa type of Hokkaido, the Kosegawsawa type in northern Honshu near the Sea of Japan, and the Yanagimata type in central and western Honshu. The Tachikawa type bears strong morphological resemblance to the contracting-margin stemmed-point bases from the LU3 layer at Cooper's Ferry.

Davis lecturing on the stratigraphy of Cooper's Ferry Area B, 2017.

Stemmed projectile points morphologically different from specimens at Cooper's Ferry appear at the Ushki Lake site in Kamchatka by 13,440–12,640 yr B.P., but were absent earlier from Beringia, which suggests their origins lie elsewhere. The age, morphology, and technology of Cooper's Ferry LU3 artifacts share notable similarities with the non-fluted projectile point traditions dated to 13,000–16,000 yr B.P. in Japan.

Davis and colleagues interpret this temporal and technological similarity as possible evidence for a cultural connection with Upper Paleolithic northeastern Asia, which fits in with the current evidence of shared genetic heritage between late-Pleistocene peoples of east Asia and North America. Fumie Iizuka, a project scientist affiliated with the Social Sciences, Humanities, and Arts Department at the University of California, Merced, who researches production of ancient pottery in Northeast Asia, notes that the morphology of Cooper's Ferry stemmed points is strikingly similar to that of stemmed points from Northeast Asia, especially from sites on the Japanese island of Hokkaido dating to 16,000–13,000 yr B.P. Other stone tools found at Cooper's Ferry resemble those made and used on Hokkaido at the same time. Davis and colleagues claim that the similarity is no coincidence. They interpret this temporal and technological affinity between the stemmed projectile points of Cooper's Ferry and those of Northern Japan as a cultural connection with Upper Paleolithic Northeast Asia, which aligns with current evidence of shared genetic heritage between late-Pleistocene peoples of east Asia and North America.

Genetics studies clearly show that eastern Asia was the homeland of the forebears of the First Americans. For Davis this means we must look there for the origins of the blade, biface, and osseous technologies present in the 15,500–14,000 yr B.P. artifact assemblages of the Americas. Although the Siberian Upper Paleolithic archaeological record shows clear linkages to later assemblages in eastern Beringia, Siberian linkages to the late-Pleistocene assemblages south of the ice sheets are less clear. Stronger connections to the earliest assemblages of North America may be found in other parts of Asia, such as Hokkaido, with its diverse Upper Paleolithic assemblages.

Although these archaeological connections require further study, the contemporaneous use of stemmed-projectile-point technologies in northeastern Asia and North America during the late Pleistocene betokens an emerging Upper Paleolithic archaeological pattern that precedes the Clovis Paleoindian Tradition. It brings the earliest archaeological period of the Americas into alignment with the rest of the world and confirms the technological connections to northeast Asia.

Finding more early sites—not an easy task

The challenge now is to find a connection between Cooper's Ferry and a handful of other early sites in North and South America and thereby validate the common origin for stemmed points. To find the earliest sites, Davis says we must embrace new thinking. "I don't have a lot of hope that we'll easily find other intact sites predating Clovis simply by conducting surface surveys and shallow excavation methods. We need a more-robust integration of geoarchaeological perspectives for our search to succeed," Davis says. "I like to think about where deposits older than Clovis might be found in particular kinds of regional landscapes."

In the western U.S., finding terrestrial deposits that date to the period between the Last Glacial Maximum (23,000 years ago) to the time of Clovis (13,000 years ago) is an intimidating challenge owing to tremendous environmental changes in the transition from glacial to interglacial conditions. Consider, for example, if oceangoing people arrived on our shore during this period and made a campsite at the water's edge, the site and its artifacts today probably lie under 100 m of water.

This is, after all, the Pacific Rim, the "Ring of Fire," where

earthquakes and volcanoes wreak havoc on the landscape. Occasionally an especially cataclysmic event occurs that can obliterate all evidence buried in the landscape. Such an event was the Missoula Flood, also known as the Spokane Flood (**MT 17-3,** "Sentinel Gap: Living on the edge 12,000 years ago"; **MT 32-3,** "Megafaunal remains in the Willamette Valley"). An ice dam plugged the exit of a deep valley in the Rocky Mountains, creating a sprawling lake containing 500 cubic miles of water. When the ice dam failed—evidence indicates it failed many times toward the end of the Ice Age, but most spectacularly about 14,500 yr B.P.—the contents of Lake Missoula gushed out with a flow *10 times greater than all the rivers of the world*. Enormous blocks of basalt were tossed about, and a great portion of the Columbia Plateau was stripped clean of millions of years of loess down to bedrock. Canyons were carved in basalt, and water-borne sediments and debris were deposited in vast accumulations more than 125 ft deep over an area of 500 sq miles. We'll never know how much archaeologically significant matter was stripped from the plateau or buried forever under enormous deposits.

Ken Ames (*left*) conferring with Davis at the Cooper's Ferry site in July 2017. Ken Ames, at the time professor of anthropology at Portland State University and archaeologist, "specialized in the Columbia River Plateau region and the Northwest Coast," Davis tells us. "Ken directed the excavation of the Hatwai site, an early Western Stemmed Tradition site near Lewiston, Idaho. Ken was a major thinker about the early archaeology of the interior Pacific Northwest. I invited Ken to visit our excavation at Cooper's Ferry on several occasions, and we shared many great discussions there. He was a great colleague, and I admired his way of thinking about the archaeology of the Pacific Northwest very much. Unfortunately he passed away in 2019, and we all miss him very much. I dedicated the 2019 *Science* paper about the early occupation at Cooper's Ferry to him."

An extreme case like this emphasizes the maxim, "To find evidence for human presence 16,000 years ago, first find 16,000-year-old sediments." That's the task geoarchaeologist Loren Davis faces.

Technological comparisons in the Americas

While it's true that the artifacts recovered within the LU3 layer at Cooper's Ferry partially overlap with the Clovis Paleoindian Tradition, they also bespeak a separate technological tradition distinguished by flake- and macroblade-based lithic technology. Not only are the two technologies different, neither appears to have derived from the other. Evidence from sites in the Intermountain West like Cooper's Ferry suggests that stemmed points may very well predate Clovis. Sites in Texas like the Gault and Friedkin sites show that stemmed points extend deep in time in North America and may indeed be the earliest point style in North America brought by the first migrants.

There's little doubt that Clovis originated south of the continental ice sheets by 13,000 years ago. CSFA Director Mike Waters writes in his recent report in *Science* that we should therefore look for the origins of Clovis in the biface, blade, and osseous technologies that make up the 15,500- to 14,000-year-old North American assemblages.

Hints of this transition are found at the Friedkin and Gault sites in Texas. For example, if we look at evidence from Area 15 at the Gault Site, it demonstrates the presence of a previously unknown projectile-point technology in North America before 16,000 years ago. The physical and cultural stratigraphic evidence recovered from Area 15, as well as associated OSL dating of silt-sized quartz grains, consistently show a coherent sequence of the Gault assemblage, Clovis, late-Paleoindian, early-Archaic, and middle- to late-Archaic occupations over a span of more than 16,000 years. This sequence corresponds nicely with previous studies in central Texas. Distinct differences in lithic technology between Clovis and the Gault assemblage, which includes stemmed projectile points, and the stratigraphic separation between the cultural depositions clearly declare discontinuity between the two complexes.

Similarly, researchers reported an assemblage of stemmed projectile points associated with other artifacts below a Folsom and Clovis artifact-bearing layer at the Debra L. Friedkin site along Buttermilk Creek, Texas. This layer, located just 250 m downstream from Area 15 of the Gault site, was dated to 13,500–15,500 thousand years ago. The earliest stemmed points elsewhere in North America are found in the Intermountain West at Paisley Caves, Oregon. Taken collectively, the evidence from Friedkin, Gault, and other sites suggests that the earliest known people to enter the Americas were using stemmed points.

Davis considers the Cooper's Ferry, Gault, and Friedkin sites special "because they contain evidence that stemmed-projectile-point technologies overlap with and predate fluted-point technology in the Americas. The Gault and Friedkin records are important because they contain such a large number of lithic artifacts in deposits stratigraphically below a buried Clovis component."

Future studies of these earliest lithic assemblages will yield information about the technological patterns that were used by people before the appearance of Clovis. "While I've only been able to study some of the lithic artifacts from the Gault site and have read about the lithic technology from the deepest component at Friedkin, it seems to me that the three sites may ultimately share similar core- and flake-production technologies,"

Davis says. Although stemmed projectile points present at all these sites differ in their morphology, for Davis the morphometric differences of end products, like projectile points, aren't as significant as the similarity of larger patterns of lithic reduction.

Getting the message out

Davis's most recent paper in *Science* describes the early record from Area A of Cooper's Ferry, which is located on the western side of the site. He intends to continue publishing papers about this record and, ultimately, a larger monograph about the site. He finds it wonderful "to see the news of our discoveries at Cooper's Ferry spread far and wide—read by millions of people around the world. In addition to seeing the international media attention this story has attracted, it's been great fun to share the story of what we found at the site with the public, especially through local radio interviews and newspaper stories that reach smaller regional communities." MT

– Katy Dycus

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Suggested Readings

Davis, L., et al. 2019 Late Upper Paleolithic occupation at Cooper's Ferry, Idaho, USA, ~16,000 years ago. *Science* 365: 891–97.

Waters, M. R. 2019 Late Pleistocene exploration and settlement of the Americas by modern humans. *Science* 365, eaat5447.

Siberian roots of the First Americans

continued from page 4

The long, complicated population history of NE Siberia

Willerslev, in an interview with the Naked Scientists website, said there had been "a lot of mystery" connected to the population history of northeastern Siberia. This was "because the archaeological record goes back more than 30,000 years for this area, while if you look at contemporary people and their genetics it suggests that the history is no older than about 10,000 years." He added that owing to the extremely cold environment of northeastern Siberia, it was widely assumed that "the population history of northeastern Siberia has been very simple. . . . It's not like many migrations, or many different people wanted to go up there." But now, thanks to the work done by him and his team, we can see this is definitely wrong.

Ancient North Siberians, a population unknown to science prior to the sequencing of the genome of the Yana RHS individual, became ancestors of Native Americans in a complicated sequence that spans almost 20,000 years:

- About 38,000 years ago, Ancient North Siberians split off from Western Eurasians.
- Sometime around 30,000 years ago, a group diverged from an ancestral East Asian population and moved into Beringia. This group then diverged around 24,000 years ago into two groups.
- Between 20,000 and 18,000 years ago, the descendants of the Ancient North Siberians (which include Mal'ta) intermingled with these two populations, creating two unique groups. One became the Ancient Paleo-Siberians, who would populate Siberia. The other gave rise to both the Ancient Beringians and Native Americans. Once the massive glaciers had receded from the coast and opened a corridor to the continental interior, this Native American population spread rapidly into North and South America, thereby completing humanity's interrupted journey out of Africa and across the globe. MT

– Brad Lepper

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Suggested Readings

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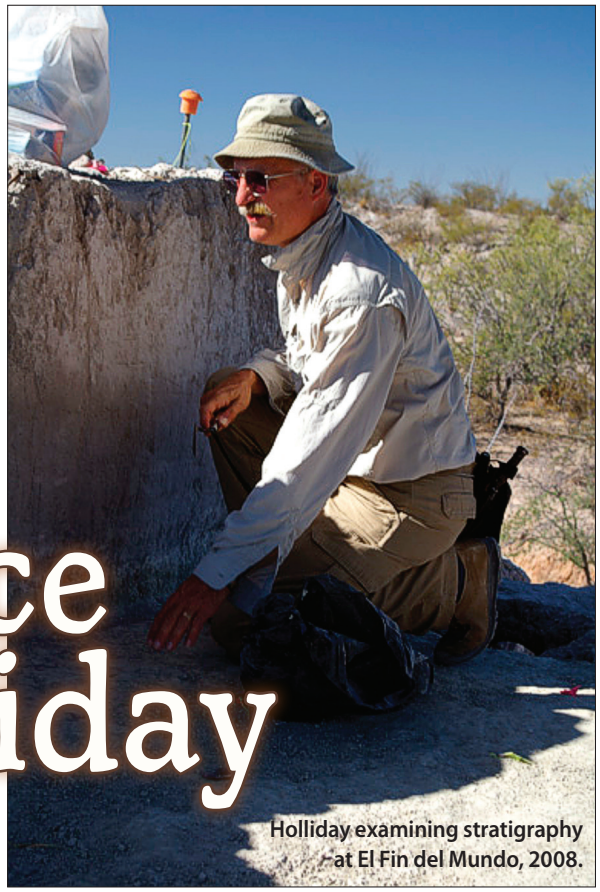
Stone, A. C. 2019 Human lineages in the far north. *Nature* 570: 170–72.The long, complicated population history of NE Siberia.t

More than a "Texas dirt archaeologist"

Vance Holliday



Holliday examining stratigraphy at El Fin del Mundo, 2008.

GREG HODGINS

GEOARCHAEOLOGIST Vance T. Holliday of the University of Arizona developed an early fascination with old mummy movies, which branched into a life-long passion for history in all its aspects—from personal family history to human evolution. He didn't find the designation "Texas dirt archaeologist" demeaning when it was applied to him by his first boss, David Dibble, Director of the Texas Archaeological Salvage Project at the University of Texas. Holliday considered it a compliment that confirmed he was a competent field archaeologist. He feels fortunate to have been able to focus much of his research and teaching on the geoarchaeological aspects of his other primary interest, Paleoindian archaeology.

Near the end of junior college and planning to attend the University of Texas, Holliday experienced an epiphany while watching an old television documentary called "The Man Hunters," an interdisciplinary study of a rockshelter in France. *That* was what he wanted to do, and he completed a B.A. in Anthropology, with honors, at UT in 1972.

Colleague David Meltzer of SMU says, "There are few geoarchaeologists not named Vance (Holliday or Haynes) who can be said to have worked on or made as many fundamental contributions to our understanding of Paleoindian sites on the Great Plains. The long list of sites Holliday has investigated includes such iconic localities as the Clovis, Folsom, Midland, and Plainview type sites, as well as Lindenmeier, Miami, Milnesand, San Jon, and especially Lubbock Lake—where, in collaboration with Eileen Johnson, Vance has devoted decades to its chronological and stratigraphic record and made it an exemplary model of a geoarchaeological field investigation [**MT 18-4,** "Lubbock Lake]. Vance is a wonderfully nice fellow, but make no mistake: He has a strong sense of scientific integrity and ethics, and if he spots someone playing fast and loose with evidence, he will go after them, as evidenced by his unwillingness to let the dubious claims of the Younger Dryas Impact Hypothesis go unchallenged." [The Clovis Comet is a hotly contested hypothesized event that purportedly accounts for many anomalous features that characterize the Younger Dryas period. We reported extensively on this controversial extraterrestrial event in *Mammoth Trumpet* beginning with MT 23-1. *–Ed.*]

"Vance and I have been on a very long journey together and apart since 1973," says Eileen Johnson of Texas Tech. "We have been colleagues and research partners, with concurrent and divergent views, occasional disagreements, and compromises. The trek we've taken across the Llano Estacado has been amazing, and it's not over yet. When I think of Vance's career and my own, I am reminded of my favorite Robert Frost poem and its last three lines:

'Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.'

Vance has taken the road less traveled by, and by that choice has greatly contributed to the development of geoarchaeology as a recognized and important discipline on a global basis. He is an accomplished Quaternary scholar influencing today's and the next generation of Quaternary researchers."

ALEXANDER OTCHEREDNOY

Holliday and John Hoffecker working on a section at Shlyakh, Russia, 2013.

An early career path that "wandered a bit"

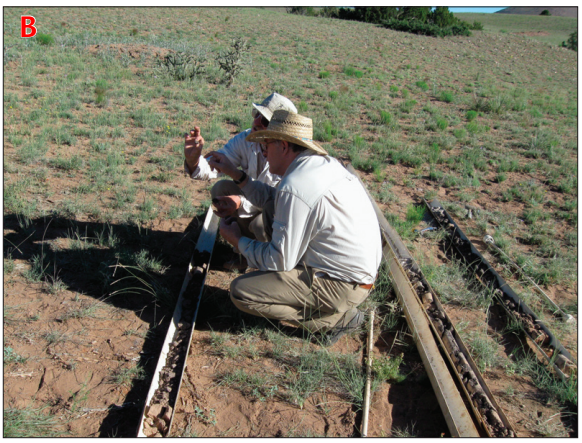
An initial experience as an undergraduate at UT working under Dibble soon led Holliday to Texas Tech, where he worked at the Lubbock Lake Site on a research-oriented study of Paleoindians and completed a master's in Museum Science with a minor in Soil Science. The conferences, field trips, field work, lab work, and report writing involved in his work with Eileen Johnson helped Holliday realize that he was more interested in the sediments surrounding artifacts than in the artifacts themselves.

"When I had the opportunity to work at Lubbock Lake, I jumped at the chance to join research on a well-known Paleoindian site," Holliday says. "The amazing stratigraphy there almost instantly catalyzed my interest in the geo side of geoarchaeology. That then exposed me to broader issues in archaeology, geoarchaeology, and Quaternary geology, especially soils." With this new direction in mind, Holliday pursued a Ph.D. in Geology at the University of Colorado, Boulder, which he completed in 1982.

Holliday joined the University of Wisconsin to teach courses on soils and geomorphology, where his classes included some graduate students in geoarchaeology. He was able to incorporate his Paleoindian geoarchaeology research into geomorphological studies on the Southern High Plains funded by the National Science Foundation.

When in 2002 the eminent Paleoindian scholar and geoarchaeologist C. Vance Haynes retired from the University of Arizona, Holliday filled his senior-level position in both Anthropology and Geosciences. The leadership change was seamless, thanks to the long tradition of ties between the two disciplines at UA. With the position came his appointment as Executive Director of the Argonaut Archaeological Research Fund, a privately endowed research fund at UA (**MT 18-1,** "A campaign to find the First Americans"). Argonaut has been a key funding source for his work on Paleoindian geoarchaeology across the great Southwest.

JESSE BALLENGER



PATRICIA WALKER

DAVID MELTZER

A Bead found during coring at the Mockingbird Gap site, NM.

B Examining a core at the Water Canyon site, NM: University of New Mexico archaeologist Robert Dello-Russo (*front*) and Holliday.

C Holliday and geoarchaeologist James Mayer coring near the Murray Springs Clovis site, Arizona, 2005.

D At the Folsom site, 1992: (*left–right*) Vance Haynes, Dennis Stanford, and Holliday.

Clovis in the shadow of the A-Bomb

In the late 1950s geologist Robert Weber discovered Mockingbird Gap, a Clovis site located near the place where the first atomic bomb was tested in 1945. Weber worked for the New Mexico Bureau of Geology, but had life-long interest in Paleoindian archaeology. His extensive geologic mapping gave him the opportunity to look for artifacts. Weber mapped the site; serious investigation began after University of New Mexico archaeologist Bruce Huckell and Holliday visited the site with Weber in 2004. On a low ridge they discovered at least a dozen separate clusters of Clovis artifacts scattered on the surface, which suggested either discrete campsites of small Clovis groups or repeated occupations over time by a single group (**MT 23-4,** "Mockingbird Gap: A mid-century discovery gets another spin").

A swale at the north end of the site had escaped extreme erosion. A thin layer of sand in the swale covered much of the site, and this is the area Huckell excavated. Holliday chose to core the adjacent Chupadera Wash, which during Clovis time was a stream and wetland system lying more than 10 m below the ridge and swale.

Huckell's excavations produced many endscrapers but few blades, which indicates the site may have been used for working hides. During the 2007 season a large percentage (49.2%) of artifacts at Mockingbird Gap were found to be made of obsidian acquired from an unknown source that must have been nearby.

Holliday as a workmate earns high praise from Huckell. "Working with Vance for nearly 20 years has been a real pleasure from both a scientific and personal perspective. We first met during Dave Meltzer's work at the Folsom type site, and af-

ter he moved from Wisconsin to Arizona in 2002 we began collaborating on archaeological and geoarchaeological research at the Boca Negra Wash and Deann's, both small bison-kill/short-term Folsom camp sites (the latter discovered in 2001, named for survey-crew member Deann Muller) separated from one another by about 2 km. That led to joint investigations at the Mockingbird Gap Clovis site in the years 2005–2007 and at White Sands National Monument, work that continues to this day. His generous support of this work using Argonaut Archaeological Research Fund resources is a testimony to his collaborative and inclusive research perspective. Vance's skills in deciphering Quaternary sedimentary deposits and soils, as well as his superior knowledge of military armored vehicles, have provided a lot of memorable discussions."


DIANE HOLLIDAY


GREG HODGINS


SHANE MILLER

E At the Lindenmeier site, 1995: (*left–right*) Holliday, National Park Service archaeologist Adrienne Anderson, and Vance Haynes.

F Examining a Clovis point at El Fin del Mundo, 2010: (*left–right*) Holliday, Shane Miller, and David Meltzer.

G Near Folsom, NM, 1990, at the grave of George McJunkin, who discovered the original Folsom bone bed: (*left–right*) Vance Haynes, Jack Hofman, Holliday, and David Meltzer.

H Holliday at the Clovis type site, NM, 2011.

A chronicle of the changing land inhabited by Clovis

The Clovis occupation of the Americas is the most geographically extensive of any time period, testifying to the remarkable mobility and adaptability of the Clovis people. A chapter written by Vance Holliday and Shane Miller in the CSFA book *Paleoamerican Odyssey* addresses Clovis adaptability and explores the environmental conditions and the rate and direction of environmental change along with differences in land use. Their approach—a synthesis of Clovis-age landscapes and climates—helped develop a "snapshot" or "slice" of the landscape occupied by Clovis foragers during the final millennia of the Pleistocene and the beginning of the Younger Dryas chronozone. (Holliday emphasizes that "the Younger Dryas is the final millennia of the Pleistocene, and Clovis folks were present only in the first few centuries. Folsom is the classic assemblage of most of the YD.")

When CSFA Director Mike Waters asked Holliday to write a chapter for *Paleoamerican Odyssey* that synthesized Clovis environments, he recalls agonizing over how to approach the task. "I am not a paleobiologist," he admits, "though I could summarize their work. Then I got to thinking about the physical landscape literally under the feet of or in sight of Clovis foragers; landforms, hydrology; glaciers, sea level, etc. No one had synthesized that story. So that is how the chapter came to be. Turned out to be an absolutely fascinating project. I learned so much and I ended up with far more information than I could use in the chapter. I am using much of what I turned up as part of a book project synthesizing the post-full-glacial late-Pleistocene landscape of North America."

The climate and landscape encountered by Paleoindians at the end of the Pleistocene was unlike anything experienced by later occupants. Sea level was lower than now but rising, and glaciers were widespread; the continent was undergoing rapid environmental changes from the late Last Glacial Maximum (LGM) to the Holocene, a time slice not often studied.

Although their focus was not on flora and fauna, they found that the distribution of past plant communities indicates rapid transition during most of the North American Paleoindian occupation. Some plant associations then existing have no counterpart today. The wide excursions in North American climate during this time underscore the importance of pursuing a balanced study of global climate change and changes at the local scale, which were clearly both significant and widespread.

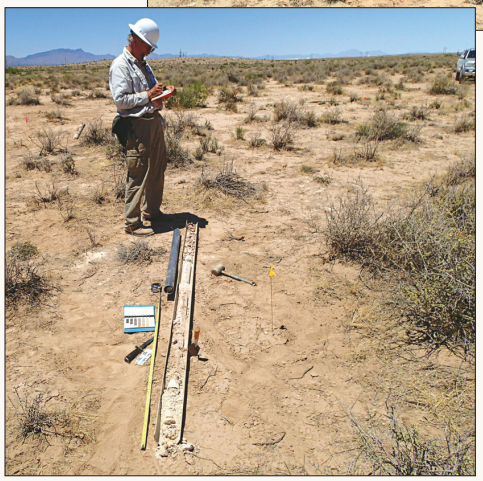
The location of glacial ice and the Clovis-age coastline helps define areas where the First Americans came from and what landscapes were available for occupation. Glaciers still covered large parts of Canada and the higher Cascade and Sierra Nevada

Adventures in Soil Coring

A Giddings soil-coring rig is hydraulically driven and uses brute force to push a barrel into the ground to recover a core the length of the barrel (ours are 120 cm long and 5 cm in diameter). Depth is dependent entirely on what we are coring. If we hit a rock or a resistant layer such as dense calcium carbonate ("caliche") we come to a dead stop (the core "refuses"). Otherwise, we can go quite deep. My record is 15 m. Typically our cores are in the range of 2–6 m long.

I first got interested in this technology as I worked on the geoarchaeology of the Southern High Plains. The famous Paleoindian sites such as Clovis, Plainview, and Lubbock Lake are buried deep in the draws (dry valleys). Other buried sites such as San Jon and Miami are in playas (generally dry lake basins). To reconstruct regional site contexts, paleoenvironments, and landscape evolution, the Giddings rig was just what we needed. With support from NSF, I carried out a systematic study of draws and playas in the region based largely on cores. In the draws we recorded almost 400 cores (plus natural and artificial exposures) from about 100 localities (only a few of which were archaeological sites). We also cored about 30 playas. Scores of radiocarbon samples from the cores helped to build chronologies of deposition in both settings, which aided in reconstructing environmental changes. A book on the draw research won the 1998 *Kirk Bryan Award* of the Geological Society of America.

BOTH: ALLISON HARVEY



▲ **Holliday coring at a Paleoindian site on the White Sands Missile Range, NM, 2014.**

◀ **Describing a core at White Sands.**

We continued the coring work when I joined the University of Arizona. We cored draws and playas across southern New Mexico and Arizona, and added paleo-lakes and alluvial fans to our repertoire. We had several unusual discoveries. At Mockingbird Gap we were trying to understand why there was such a high concentration of Clovis stone artifacts along Chupadera Wash. The floor of the draw today is not much lower than the level of the site. What we discovered by coring is that during Clovis and Folsom time the floor of the Wash was over 10 m deeper than it is now. The Clovis people were living along a small canyon that dropped off over 30 ft to a mixed stream and wetland setting. That was an obvious attraction. In one of our cores, at over 9-m depth we found a Folsom-age bead made of calcium carbonate (published in 2013 in *Current Anthropology*). In my experience and that of my geoarchaeological colleagues who use coring devices, discovery of stone tools or bone is exceedingly rare.

Our stratigraphic studies suggested that the Mockingbird Gap campsites, like those at Lubbock Lake and Blackwater Draw, were located near a wetland environment. Radiocarbon-dated core samples established an age of 9000–11,000 RCYBP and confirmed that what is now desert grassland was then a much wetter environment.

The coring also was instrumental in our work at the Water Canyon site in New Mexico. During testing along an arroyo, working with Robert Dello-Russo (Office of Contract Archaeology, University of New Mexico) we realized we had a buried Paleoindian site. Such sites in buried contexts are quite rare in the Southwest. Water Canyon was the first one discovered in New Mexico west of the Pecos River in several decades. To understand the distribution of Paleoindian-age strata and the paleo-topography and to guide excavations we undertook a program of subsurface investigation that recovered 75 cores. In one area of the site in an area of less than 10 m^2 we hit bone at ~3.5-m depth in 5 cores. That got our attention. Robert subsequently opened the area and exposed a bison bone bed with an Eden point.

– Vance Holliday

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ranges, but most continental glaciers were retreating long before the arrival of Clovis people, leaving behind vast till plains. As the glaciers melted and ice fronts receded, the rising sea level covered coastal areas that had once been occupied. Holliday tells us that "across the continent the hydrology, and all geomorphic and depositional processes underwent massive changes."

The picture of North America during the spread of the Clovis culture shows a remarkably dynamic environment with

broad trends and detailed changes at different rates and in different directions.

"The data we have now suggest there were few people in the Americas prior to the Clovis occupation," Holliday says. "But based on numbers of sites and artifacts, there was a population explosion of sorts in Clovis time with people living in North America from coast to coast. To me that is still a great mystery. Was there a large pre-Clovis population we just aren't seeing or finding? Where did Clovis artifact assemblages evolve? We don't see colonization (which I take to mean people settling much or most of each continent) until Clovis assemblages appear in North America. A lot of my work focuses on building chronologies both in terms of stratigraphy and numerical dating. I worked on this extensively on the Great Plains because we have so many stratified Paleoindian sites."

A one-of-a-kind Clovis kill site in Mexico

The site El Fin del Mundo (Spanish for *The End of the World*) was discovered by a rancher in Sonora, Mexico, who noticed large bones and artifacts eroding out of an arroyo wall. In 1999 Vance Haynes and University of Arizona graduate student Guadalupe Sánchez, when investigating the area, were told of the find. "But it wasn't until we had the Argonaut funding in place," Holliday explains, "that we could support Guadalupe's visit to the site as part of her broader research into Clovis archaeology in the state of Sonora just south of Arizona." The large bones belonged to gomphotheres, megamammals from the proboscidean family previously thought to have gone extinct earlier in the Pleistocene. Remarkably, the bones were found in association with Clovis artifacts, indicating that the animals were part of the Clovis diet. El Fin del Mundo is currently the oldest Clovis kill site yet discovered (**MT 30-3,** "El Fin del Mundo: News from the end of the world . . . as we know it?") It's only the second Clovis site yet discovered in Mexico, and the only gomphothere kill site in North America.

Holliday, one of the primary researchers of the site, and Sánchez could only reach the isolated site in the Sonoran Desert after a rough three-hour journey over volcanic hills far from the nearest paved road. Excavated between 2007 and 2012, the site revealed a Clovis camp and butchering area, heavily eroded. Flowing water had carved islands in the sediments and destroyed evidence of the stratigraphic relationship between the islands and surrounding deposits.

Two bone piles with disarticulated skeletons of two proboscideans—at first thought to be mammoths or mastodons—were later identified by their unique molars as gomphotheres. Examining the teeth also helped determine the age of the two gomphotheres, animals long thought to have disappeared from North America before the arrival of humans. Four Clovis points, fluted lanceolate bifaces that demonstrate skilled pressure flaking, were found near the bones, one within 60 cm of the mandible. Bits of broken teeth and bone appeared beside, above, and below the points. A nearby broken artifact, the distal end of a Clovis point, exhibited a snap break usually associated with an impact fracture. (Clovis points were multipurpose: They served as projectile points for hunting and as knives for butchering and for preparing vegetal material.)

Disarticulated bones gathered into two piles led researchers to believe the animals were butchered by humans and later disturbed by scavengers. Holliday admits, though, the severely weathered bones make it impossible to know for sure. The most reliable date for the site, taken from a piece of charcoal, is 13,325–13,440 yr B.P., which extends the previous ancient limit.

Guadalupe Sánchez's work at El Fin del Mundo became part of her dissertation titled *Los Primeros Mexicanos,* which she later published as a book. She is now a professional archaeologist in Hermosillo, Sonora.

Recalling his experience at the El Fin del Mundo site, Holliday tells us, "One of the great opportunities provided by the Argonaut funding is working in northern Mexico alongside Mexican archaeologists."

"A lot of my work focuses on building chronologies both in terms of stratigraphy and numerical dating," Holliday explains. "I worked on this extensively on the Great Plains because we have so many stratified Paleoindian sites. Working in the Southwest has been a very different experience, however, because buried, datable stratified sites are very rare west of the Pecos River valley. I've been fortunate to work on several of the rare buried sites in the Southwest (El Fin del Mundo and Water Canyon) and contribute to the archaeological chronologies."

A middle-Paleolithic blade industry in southern Russia

Holliday and colleague John Hoffecker of UC Boulder in 2013 visited Shlyakh, an open-air site located near Volgograd in southern Russia, to collect new archaeological data and to perform new dating of the area. The site presents a challenge, since materials deposited 50,000–40,000 years ago lie at the limit of radiocarbon dating. Ancient human DNA extracted from skeletal remains indicates that the local Neanderthal population was being replaced by an incoming population of modern humans and that local Middle Paleolithic industries were being transformed.

More than 5,700 artifacts were recovered at Shlyakh between 1990 and 2000. New stratigraphic profiles, along with soil micromorphology, gave a more detailed picture of the context of the site. New dating research confirmed earlier results, based mainly on paleomagnetic stratigraphy. When Shlyakh was occupied, roughly 40,000 yr B.P., both Neanderthals and modern humans appear to have been present in Europe.

Holliday remembers the experience of working on site as "a fun project with great Russian colleagues." Satisfaction was assured from the start: The region is the Russian equivalent of our Great Plains, and Holliday found the stratigraphy interesting. For him, "It was like being home."

"Vance and I first worked together in the summer of 1974, when he was a first-year grad student and I was still an undergrad," says Hoffecker. "Vance was the Clovis area crew chief at Lubbock Lake and I was on the crew. In 2001 we worked together once again, this time in Russia at the Kostenki sites with a group of Russian colleagues and students (technically, I was the PI and Vance was the project geoarchaeologist) and we have continued to collaborate on the field and lab study of Paleolithic sites in Russia and Ukraine ever since, including Mira and Shlyakh.

"Vance has made a major contribution to Paleoindian archaeology in North America and Paleolithic archaeology in Eastern Europe. And we've had a lot of fun doing this work together all these years."

Honors and awards galore

Holliday was recognized as a "Titan of Texas Archaeology" by the Texas Archaeological Society. The list of his honors, awards, and grants and his many publications would fill an entire issue of *Mammoth Trumpet*. Holliday's 1997 book *Paleoindian Geoarchaeology of the Southern High Plains* yields important information about cultural chronology and paleoenvironments across the region.

In 2018 Holliday received the Roald Fryxell Award for Interdisciplinary Research by the Society for American Archaeology. He acknowledges that he owes a large measure of thanks to some of the scientists we mention in this article. It's a most prestigious award, especially considering that Vance Haynes was the first to receive the award exactly 40 years before. Holliday, who was in the audience at the 1978 SAA Conference when the award was announced, remembers thinking, "That is so cool"!

VICTOR POPOV

John Hoffecker and Holliday indulging their shared interest in military history at a museum in Voronezh, western Russia, 2003.

About the future

"There is so much to do!" Holliday tells us. "Access to the White Sands area in southern New Mexico opened up so many research opportunities. Most of the Tularosa Basin is owned by the military or the National Park Service, and the military holdings extend north into the Jornada del Muerto Basin (almost to the Mockingbird Gap Clovis site). That means that most of the Paleoindian sites over a huge area (measuring about 140 by 50 miles) were never collected and we can visit most of them (with the generous and enthusiastic help of the personnel out there). So, we can document literally hundreds of sites from all Paleoindian time periods in a variety of landscape settings. Paleo-lakes and playas have fascinated me since I started graduate school and began working on the High Plains. As a result, I developed an interest in investigating the relationship between the First Americans and the evolving lakes scattered across the Great Plains and the intermountain West. We have Paleoindian sites scattered across much of southern and central New Mexico, thus a great opportunity to pursue that research.

"I also plan to continue work with the National Park Service and other agencies on the remarkable record of mega-fauna tracks and human tracks at White Sands National Park. This is also a remarkable and unique research opportunity (and linked back to a paleo-lake record) (**MT 34-4,** "Ghost fossils: A Pleistocene trackway and possible kill site at White Sands, New Mexico"). Because of the international reputation of archaeology and paleoenvironmental sciences here at the UA, we attract a wide array of first-rate graduate students from around the world."

– Martha Deeringer

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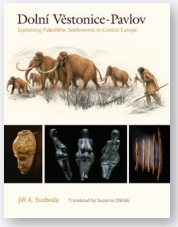

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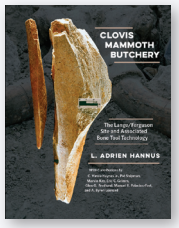

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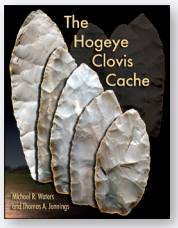

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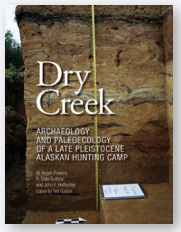

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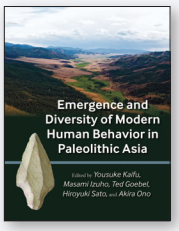

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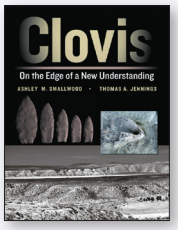

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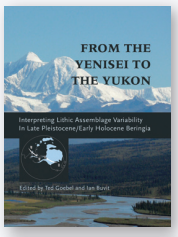

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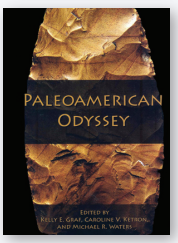

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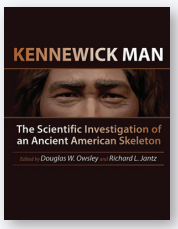

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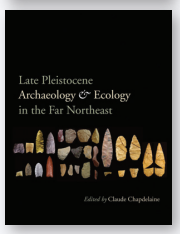

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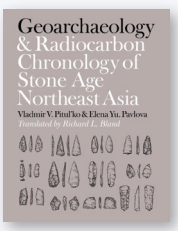

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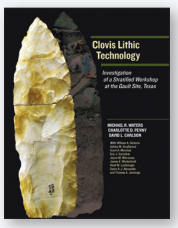

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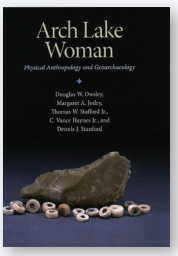

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