



MAMMOTH TRUMPET

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See inside rear cover

A Way Station for Pre-Clovis Travelers?



T. W. STAFFORD, JR.

Wind-whipped waters of Pleistocene Lake Chewaucan created these caves, the Paisley Caves in south-central Oregon. Hunters attracted to game that abounded in the lush lacustrine setting sheltered here, says University of Oregon archaeologist Dennis Jenkins. His evidence? Extinct megafaunal bones, lithic artifacts and debitage, and the corker: human coprolites (mummified feces) that date to between 14,170 and 14,340 CALYBP. That's nearly 1,000 years older than the earliest Clovis occupation. Finding the coprolites, it turns out, was the easy part of the job. Now Dr. Jenkins has to convince skeptics of the validity of his find. Some contend radiocarbon-dating samples must have become contaminated, others insist the coprolites aren't human waste at all. Part I of our two-part series on Jenkins's continuing labors at Paisley Caves and in the laboratory starts on **page 16**.

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

MAMMOTH TRUMPET

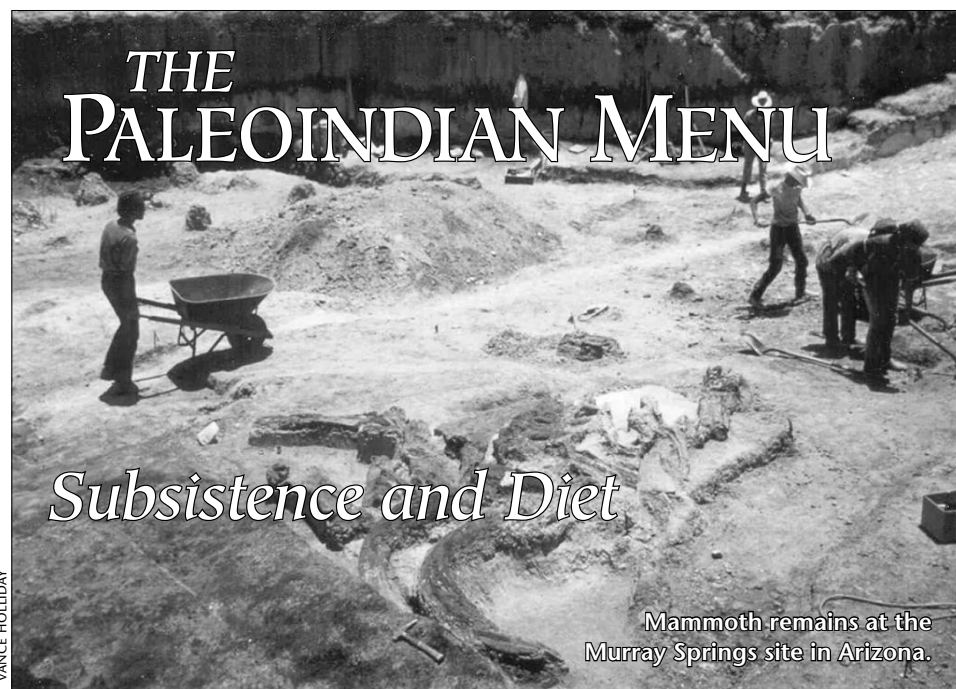


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VANCE HOLLIDAY

HOW DID Paleoindians, particularly Clovis people, fill their larders? Four decades ago anthropologist Paul S. Martin captured the attention of the scientific community with his Blitzkrieg theory, which argues that human hunters were responsible for the extinction of megafauna at the time of the Pleistocene/Holocene transition. Whether believed or scoffed at, his model for megafauna overkill has stimulated multidisciplinary research into every conceivable nook in the Quaternary record—fossil pollen, packrat middens, even coprolites. Disbelievers include such luminaries as the late University of Alberta anthropologist Alan Bryan,

who contended that our obsession with the image of the specialized big-game hunter chasing mammoths with a spear blunted First Americans research for half a century (MT 9-1, “The Quest for First Americans: An Interview with Alan Bryan”). In recent years authorities have offered convincing evidence that Paleoindians were indeed generalist hunter-gatherers. University of Colorado anthropologist Douglas Bamforth tells us that even the mighty post-Clovis bison hunters that occupied the Allen site in Nebraska weren’t too proud to eat prairie dog and turtle, and even stooped to gather mussels to supplement their diet (MT 24-1, “The Allen Site:

INSIDE

5 The origin of the domestic dog is disputed

Not southern China, but the Middle East is where the wolf was first domesticated, says a team of geneticists from UCLA in the conclusion of our series.

8 A new twist to the Beringian migration theory

The theory squares with genetic evidence, say two University of Utah scientists, if migrants took the northern route before glaciers barred passage.

12 Finally, South American Paleoamericans are getting the attention they deserve

Earlier than Clovis: That’s the conclusion of two scientists who painstakingly radiocarbon dated six sites in southernmost South America.

16 Are the Paisley Caves what a pre-Clovis site looks like?

University of Oregon anthropologist Dennis Jenkins says humans stopped here almost 1,000 years before Clovis. Now he needs to convince critics, authorities in their fields whose opinion matters.

Paleoamericans Seen through a Different Prism”).

Like all attempts to model Paleoindian life, however, the emphasis on

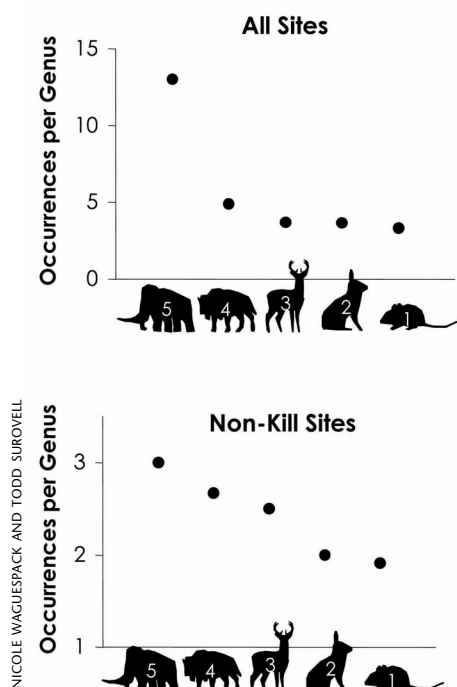
big-game hunting as the principal means of subsistence enjoys a kind of tidal ebb and flow of favor with scientists. Its boosters include University of Wyoming anthropologists Nicole Waguespack and Todd Surovell, who have reexamined the record, drawn inferences from ethnographic observation of 12 societies of subsistence hunters, and where possible quantified data regarding the general question of how foragers make economic decisions regarding prey selection. They conclude that the high incidence of Clovis sites with megafaunal remains confirms that megaherbivores, especially proboscideans, ranked high among prey selected by hunters.

large prey naturally depends on the species present in the hunting environment, as well as the hunter's skill and physical condition. Surovell and Waguespack note, however, that hunting large prey involves costs and risks for the hunter. An additional negative factor is that the larger the prey, the lower its population density. The opportunity for a successful hunt diminishes accordingly.

Nonetheless there are social benefits

associated with hunting large game. "In these societies, prestige can be earned through successful hunting," Surovell explains. "A single person can't exploit a large animal when it's killed, but he can provide other people with meat—commodities. Large game advertises status."

To obtain large mammals hunters must be highly mobile and must work strategically and cooperatively. The Paleoindian lifestyle characterized by



The relative abundance of animals by size class of remains found in Clovis archaeological sites.

Advocates of the generalist theory of Paleoindian subsistence can breathe a sigh of relief, though. Drs. Waguespack and Surovell don't preach an absolutist doctrine. Rather, they have adopted the sensible attitude that the question in point "is not whether small game was taken by early Paleoindians but the extent to which it was taken *relative to large game*."

How do hunters choose their prey?

The larger the prey, the greater the return in calories for energy invested. Hunting



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Mammoth Trumpet, Statement of Our Policy

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

—Michael R. Waters, Director

high residential mobility, advanced hunting technology, and minimal game processing supports Waguespack and Surovell's argument that these ancient hunter-gatherers consistently utilized megafauna. Although some authorities argue that the archaeological record is biased by an over-representation of megafauna kill sites, the record is the only source of information on Clovis behavior. There's also, of course, abundant *de facto* evidence: Clovis projectile points and other artifacts have been discovered in association with the remains of mammoths and mastodons throughout the continental U.S.

Considering overkill and megafaunal extinction

Waguespack and Surovell find it impossible to ignore the coincidence of large-prey predation and megafaunal extinction. "It's a coincidence that I feel many people who are proponents of Clovis hunting large game can understand," says Waguespack. "It's compelling and suggests that humans played a role." Surovell explains that "you have some 35 megafaunal animal genera doing just fine, moving through multiple glacier oscillations, and they only go extinct 12,000 years ago. What's different is that people are there." And this pattern repeats itself. "But I can't show evidence that people hunted most of the fauna that went extinct," he continues. "Is that a meaningful absence of evidence? What we have is a bunch of mammoth kill sites."

Their theory, which enjoys pretty smooth sailing for the most part, hits choppy seas here, for other authorities contend there was another difference 12,000 years ago, a landscape made increasingly desolate by changing climate. Geoscientist Russell Graham and geochronologist Tom Stafford argue that extinctions (selective, not all-inclusive, they note) occurred earlier than previously thought and at a time of major climate change; they contend that megafauna populations were already stressed when Clovis hunters appeared on the scene (**MT 22-1**, "The Timing of Megafaunal Extinctions in North America: Earlier Than You Think"). These two models aren't necessarily diametrically opposed, though. There appears to be middle ground where both sides can argue their case convincingly.

In an article jointly authored, Waguespack and Surovell explain the difficulty in quantifying Clovis prey selection: "Examined from a North American-centric perspective it is difficult to evaluate just how many proboscidean kills equate to 'a lot' versus 'a little' subsistence use." Using the Grayson/Meltzer estimate of 14 reliable subsistence associations with proboscideans constituting a benchmark, they conclude, "with some degree of confidence," that 28% to 46.7% of Clovis sites with faunal remains show strong evidence of the use of proboscideans. They explain that "in over 1 million years of archaeology spread over four continents, we have attempted to demonstrate that there is likely nothing that has yet to be documented archaeologically that compares to Clovis in terms of the frequency of proboscidean

exploitation, with the single possible exception of the lower Paleolithic of Iberia." A very bold claim, when you consider the global scope of their study.

In another study Waguespack and Surovell determine that "over 1 million years and on five continents, *Homo* has spatially excluded and driven proboscidean taxa to extinction." Examining Africa, Asia, Europe, and the Americas, they discovered 41 sites, localities, or components that provide strong evidence of spatiotemporal overlap of humans and proboscideans. Although all five continents are represented, North America and Europe are overrepresented relative to their land area.

Their conclusions, Waguespack admits, are based on sketchy data subject to interpretation. "It comes down to a handful of sites—between 14 and 20. It depends on how we interpret associations, like how many tools we need to find."

For Waguespack, the argument comes down to the question, How do we expect people to operate? Realizing there are clearly

implications beyond archaeology, she leans toward a more anthropological solution: "When it comes to a colonization event of the Americas, we don't have much to go on. How do we expect humans to respond when they enter a new landscape? That's when we enter a large theoretical perspective." She asks us to consider what our own course of action as humans might be. "In my mind," she theorizes, "when

Surovell and Waguespack in Middle Park, Colorado, 2007.



people enter a new landscape, they're going to go for the biggest animals they can to get the biggest bang for their buck, but in today's society, hunting big animals isn't something we're familiar with."

We 21st-century humans, accustomed to foraging for sustenance on supermarket shelves, are handicapped by our inability to empathize with Paleoindian hunters. We can't comprehend their resourcefulness, determination, and bravery (or foolhardiness). People have told Waguespack that hunting prey the size of mammoths is too dangerous a task for humans. She counters with historic ethnographic accounts of foraging people who hunt elephants. They accept the risk and undertake the task with confidence. What we must avoid, she insists, is projecting our own fears on people of the past.

For Paleoindian hunters, the bigger the better

Although it's hard to draw reliable conclusions from the subsistence record, Surovell and Waguespack conclude that the largest and rarest herbivores in late-Pleistocene landscapes are the species that most frequently appear in early-Paleoindian faunal assemblages. Even when samples are limited to non-kill sites, the same pattern of large-game specialization persists. Surovell notes that "the notion that people moved long distances is extremely compatible with large-game hunting."

Surovell and Waguespack borrowed data on modern hunter-gatherers to examine the possibility of specialized large-mammal hunting across Pleistocene North America. In a study of the faunal assemblages of 33 archaeological sites, they tabulated the quantity of all taxa in each assemblage. Mammoth and mastodon are the most frequently appearing species, present in 79% of all assemblages.

In biomes where large animals were plentiful, it appears that human hunters specialized in large game. As the human population increased and the population of large prey animals decreased (as a consequence, Waguespack and Surovell argue), the people practiced a more generalized subsistence strategy.

Interpreting the archaeological record

Waguespack and Surovell accept the inevitability of bias, both bias inherent in the archaeological record, and personal bias that colors how we interpret evidence. Surovell readily admits that “it’s easier to find a mammoth kill site than a site full of small mammals. The best thing is to consider how these biases might be shaping the record, how they might be affecting our perceptions of the past. We’ve made the argument that the record is biased, but it’s also telling us a fairly consistent message.”

Surovell believes that archaeologists often differ in the area of semantics. “How do you define this term ‘big-game specialist,’ for instance? It’s kinda like two people look at the same thing and one person says it’s blue and another says it’s green.” Waguespack amplifies: “Even with the current debate, we’re debating the same evidence,” she says. “We’re looking at the same sites and assemblages but interpreting them differently. I do think that with more

Bison bone in the Clovis level at the Gault site in Texas. No artifacts are seen in this photo.



MICHAEL R. WATERS

excavations, more sites being discovered, we’ll enrich the database we have to work with, but that alone won’t solve the problems because we’ll keep interpreting them in profoundly different ways.” Perhaps what’s needed here, she suggests, is greater emphasis on human behavior.

Yet another kind of bias is encountered when scientists examine Paleoindian hunter-gatherer occupations: gender bias. Waguespack’s concern is faunal remains, whose presence almost inevitably biases the record toward residues associated with male activities. Tools used to procure and process plants—generally female activities—were usually manufactured of perishable materials; consequently evidence of women’s labor in the archaeological record slips by largely unnoticed. The problem is exacerbated, she notes, when the availability of game decreases

and the consumption of lower-ranked plant resources increases accordingly to meet caloric demands. To take the true measure of the role of Paleoindian women, she insists, you have to explore the production of material goods. Otherwise you’re likely to understate the contribution of women. “The ability to devote time and energy to hunting is facilitated by the labor of non-hunting individuals,” she writes. “Women’s labor was likely to have been an integral component of the Clovis big-game strategy.” (For more on the role of women in Paleoindian cultures, see **MT 25-1, -2**, “Paleo Woman: Lost to History.”)

Surovell notes that fads come and go in prehistory and in all aspects of archaeology. “You see the popular current of the field swinging back and forth based on political opinion. We’re dealing with a poorly preserved biased record.” Waguespack believes that popular media have a hand in swinging the pendulum of cultural belief by portraying Paleoindians and colonization of the continent as sort of a myth—the version of events we want to

believe. “Before the ‘sixties,” she explains, “we liked the idea of small hardy groups that conquered this new landscape. This narrative has changed through time. In the ‘seventies, archaeologists started questioning these ideas. All this says a lot about what we want these colonizers to be.” Surovell believes it takes time to come to the truth. In his book, any scientist who claims to know anything with absolute certainty isn’t a good scientist. By his own definition, Waguespack and Surovell are good scientists. Both are quick to admit that their answers may only invite further questions.

Lessons about human behavior

Which brings us to a final question: What does all this mean for contemporary society? Surovell notes that for a lot of people, the history of North America begins in 1492. They don’t realize that there were people here at least 14,000 years before Columbus “discovered” the New World. “There’s a rich history that predates European arrival,” he says, and bound up with it is this notion of humans living as hunter-gatherers in harmony with the environment. “If I’m correct that overkill resulted from human action,” he continues, “it paints a very different picture of human life on this continent. We don’t look at this continent in isolation, we look all over the world and find that the wave of large-animal extinctions follows human presence.”

Waguespack hopes that people today can learn from this archaeological example. “In the past, people have so altered the landscape that they have to adopt a new way of life. Why don’t we pay attention and prevent these things from happening again?” Surovell laments the cruel fact that our early ancestors weren’t as conservation minded as we once believed, but instead looked for

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RELOCATING the origin of dog domestication?

An article published in the 17 March 2010 issue of *Nature* once again alters the landscape of archaeological science. A team led by Robert Wayne, Professor of Ecology and Evolutionary Biology at UCLA, claims that the origin of dog domestication lies in the Middle East, not East Asia.

Recall that part I of our series “On the Trail of the Domestic

certain wolf populations is a unique signal of admixture or ancestry. Wayne’s team’s investigations conclude that dog breeds share a higher proportion of multi-locus haplotypes unique to gray wolves from the Middle East, indicating that Middle Eastern wolves, not East Asian wolves as claimed by Savolainen, are the dominant source of genetic diversity for dogs. Wayne does, however, concede a complicating factor that other scientists

have cited, the dispersion of dogs with their human companions: If human migrations significantly displaced dog breeds across geographic regions after domestication, current levels of diversity may differ significantly from those of the oldest, ancestral population (as is indeed the case with other species, including humans).

The UCLA study, by evaluating the contribution of specific wolf populations to the genome of dogs, reveals strong Middle Eastern and, for certain breeds, European ancestry. The study did find that two East Asian breeds had higher sharing with Chinese wolves than with Middle Eastern wolves, suggesting they were derived from Chinese wolves or admixed with them after domestication, but this example is insignificant compared with the substantial sharing Wayne discovered between modern breeds and Middle Eastern wolves.

From genotype to phenotype

The *Nature* article, which emphasizes the novelty of a study of this scope, says that “genome-wide SNP analysis provides a new evolutionary framework for understanding the rapid phenotypic diversification unique to the domestic dog.” The phenotype is the physical appearance of an organism due to the interaction of its genotype—the genetic makeup of an individual—and environment. When humans practice domestication, they select certain phenotypes, which are subsequently manifested in the genome. “We looked for areas that had signals for selection, patterns of variability. We looked in regions of low variability for genes that would be interesting candidates for domestication,” Wayne says. “Top candidates were near genes involved in memory and behavior, which showed they were genes selected early in domestication,” such as the ability to read human body language. Interestingly, the gene responsible for Williams syndrome appears to play an important role in the dog genome. Humans with Williams syndrome possess exceptional linguistic and musical skills and an overwhelming propensity for social interaction; this gene would have been advantageous in domesticating dogs to promote a breed socially inclined toward humans.

In the first phase of dog domestication, Wayne explains, dogs became associated with humans and filled a variety of roles as the bond was cemented. The second phase occurred with the advent of agriculture, when humans practiced accelerated artificial selection. “When dogs came over with the



On the Trail of the Domestic Dog

Part III

Dog” (MT 25-2) offers one cogent side of the debate, focusing on Peter Savolainen’s East Asia theory. Even in light of the newly published Middle East data, moreover, the Swedish geneticist steadfastly maintains that East Asia is a more convincing candidate for the birthplace of dog domestication.

Considering the Middle East

Dr. Wayne’s *Nature* article, “Genome-wide SNP and Haplotype Analyses Reveal a Rich History underlying Dog Domestication,” which challenges Dr. Savolainen’s conclusions, is another example of the ever-changing nature of science.

Wayne’s team analyzed more than 48,000 SNPs, single nucleotide polymorphisms (SNPs are sites of common variation along the DNA), from a sample of 912 dogs representing 85 breeds, and 225 gray wolves from 11 globally distributed populations. Genomic DNA was isolated from blood samples of domestic dogs and from tissue and blood samples of gray wolves and coyotes to assess the level of haplotype (a group of alleles of different genes on a single chromosome, closely enough linked to be inherited as a single unit) shared by ancient dog breeds and specific wolf populations from China, Europe, Middle East, and North America. Analyzed haplotype sharing between dog breeds and North American wolf populations was used as a negative control because dogs do not originate there.

The presence in dogs of SNPs that are otherwise exclusive to

first people, probably 11,000 to 12,000 years ago,” he says, “they were in the second phase and were clearly desired by humans.” At this point in our timeline, the close association between humans and dogs led to dog burials, the Koster and Dust Cave sites being two examples. The third phase Wayne cites is the modern breed phase. Of the abundant breeds of dogs we see today, 80% originated in the Victorian era. “The Victorians,” he tells us, “intensely selected often bizarre traits like breeds with tucked-in faces, for example.” Rampant artificial selection created breeds that were isolated gene pools, inbred, genetically discrete. Modern breeds are the product of controlled breeding practices,

Dog remains at the Koster site.

which notably exclude mating dogs with wolves.

A steady stream of debate

Wayne notes that Savolainen’s data are based on only one sequence, a small part of the mitochondrial genome, whereas his study presents a much more comprehensive analysis of markers distributed throughout the nuclear genome in dogs and their wild progenitor, the gray wolf. But Savolainen believes this single region he chose is extremely informative. “For example,” he says, “we now know that for humans we all have a single origin from Africa—‘Out of Africa.’” This milestone discovery about human evolution, he notes, was based on analysis of the mitochondrial genome; nonetheless the results of this study have been corroborated by later studies of other markers. Savolainen emphasizes that he and his team applied exactly the same analytical techniques to their study of the origin of dogs. “Our marker is very good for our purposes,” he insists. Moreover, he detects exactly the same pattern for dogs as was

Dog remains from the Dust Cave site.

found in the human study: the full repertoire of DNA types in southern East Asia as were found for humans in Africa, and only subsets of these repertoires outside these regions. For Savolainen these parallels unambiguously demonstrate an “out of southern East Asia” origin.

Savolainen contends that Wayne’s team’s “comprehensive” study is, in fact, misleading: “Their analysis may be comprehensive concerning having a lot of DNA data, but the samples of dog and wolf are actually very meager. They don’t have a single dog or wolf sample from southern East Asia. Therefore, what they do is equivalent of doing a study of the origin of humans without having a single sample from Africa!” Savolainen emphasizes that the UCLA study didn’t include sample dogs in

East Asia from south of the Yangtze River, the region where the diversity of mitochondrial DNA is highest.

According to Savolainen, the UCLA team’s samples are based only on dogs from Europe; consequently all they constitute is a good study of the origin of breed dogs in Europe. “The SNPs are all derived from European dogs,” he says. “If you analyze dogs from other regions, for example, southern East Asia, there will be a bias in the analysis when you compare regions. This is a bit complicated to explain but means there is a very severe bias in the analysis. For an objective study, the SNPs should have been derived from dogs from all around the world, not only in Europe.”

Wayne resents the fact that Savolainen reduces this debate to sampling one point in space, considering that from this point of origin dogs must have spread quite rapidly. “We sampled breeds that are clearly East Asian, even if not from the particular region Peter focuses on, so I don’t find Peter’s argument very satisfying,” Wayne counters. “We looked across 85 dog breeds and didn’t find strong signals from East Asia, so why does the rest of dogdom have no ancestral factor from East Asian wolves?” Wayne insists that for Savolainen’s argument to have merit, his analysis should include samples from native wolf populations, but it doesn’t.

Mixing it up

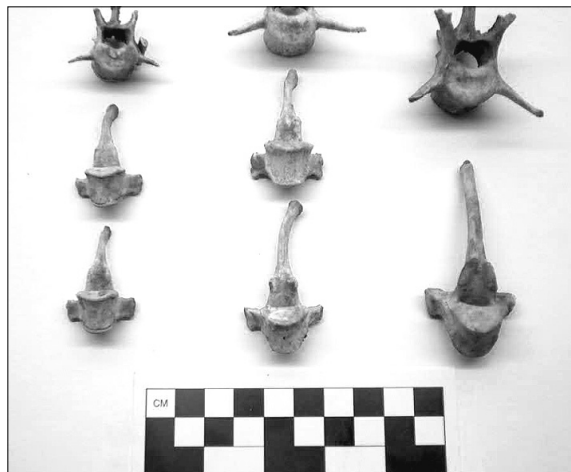
Wayne addresses the subject of trade. “The trade of dogs occurred, and dogs accompanied humans as they spread. East Asia was a center point for trade,” he says, “and right in this area, Peter sees a lot of genetic diversity. The focus of trade may have brought more dogs to this area.” Essentially, each scientist takes a different approach, tells a different story. Savolainen looks at mtDNA

to focus on patterns of diversity and to pinpoint where it is highest, Wayne says his team “focused on actual SNP genetic markers, and the averages show a greater contribution from the Middle East than East Asia world dogs.” Wayne suggests that some very old strains of dogs, with a history dating back several thousand years, may be mixed with modern breeds, exaggerating levels of diversity in certain areas such as East Asia, but Savolainen thinks this highly unlikely because Wayne’s samples “are from very rural places in China and Thailand, where there are certainly no poodles or other European dogs.”

This is where talk about the wolf/dog mixture gets complicated. Wayne admits that there is some overlap in East Asia. “Dogs may have been first domesticated in the Middle East and



CENTER FOR AMERICAN ARCHEOLOGY, MICHAEL WYANT



RENEE WALKER

then elsewhere like in Europe and East Asia,” he concedes. His *Nature* article locates the “Middle East as a primary source of genetic variation in the dog, with potential secondary sources of variation from Europe and East Asia. In contrast to the mtDNA results, East Asian wolves are a predominant source of haplotype diversity for only a few East Asian dog breeds that have a long history in that region.” Wayne believes local wolf populations have contributed to dog gene pools over long periods of domestication and suggests this may account for the presence of some East Asian breeds with a strong affinity to East Asian wolves.

Wayne recommends establishing multiple models of domestication. First, he says, “Imagine where domestication occurred in the first place. But then dogs moved around the world and interbred with wild wolf populations. That idea was copied by other cultures. So there’s independent domestication from wolves, and superimposed on that was trade and already domesticated dogs.” He says this model can also be applied to other domestic animals—camels, donkeys, sheep, and horses. He avoids attempting to pinpoint the place of origin based on genetic diversity alone. “Think of sub-Saharan dogs, roaming around villages,” he argues. “There’s a huge amount of diversity, but we know dogs weren’t domesticated there. What we see is a mixing of ancient lineages of dogs and modern dog breeds created recently. The level of diversity is a mix of ancient and modern—interbreeding between early dogs and their wild brethren wolves.”

Savolainen employs the same argument but as a counteractive: “From the mtDNA data we see that there has been mixing of dog and wolf in the Middle East, which may explain the kinship there. So, possibly the connection between dogs and Middle Eastern wolves is just because dogs have mixed with wolf.” There are six major clades (a group consisting of a single common ancestor) of mtDNA types. “A, B, and C are everywhere in the world, thus signaling a single origin of dogs. Then we see the most diverse range in the southern East Asian region,” he says. “As dogs spread across the world, that diversity is lost. Clades E and F are found only in East Asia, and clade D is not found at all in East Asia, only in the Mediterranean and Middle East. So obviously D didn’t come from where A, B, and C

continued on page 19

LIFE OF ITS OWN

OUR TRIBUTE to the life and extraordinary accomplishments of University of Alberta anthropologist Alan Bryan (**MT 25-3**, “Remembering Alan Lyle Bryan, 1928–2010”) mentions the Land Rover in which Dr. Bryan and his wife and colleague, Dr. Ruth Gruhn, traveled the length of the Americas. The vehicle still sees valuable service in First Americans studies. Now the driver is Oregon State University geoarchaeologist Loren Davis (**MT 24-3**, “Putting MUSCLE into Coastal-Entry Research”).

Dr. Davis first encountered the Bryans and their famous vehicle when he was a student at the University of Alberta in the 1990s. He recalls:

I visited Alan and Ruth at their home and saw their famous 1969 Series Ila Land Rover, which carried them to and from field projects throughout the New World. In the


spring of 2003, I was very fortunate to buy the Land Rover from Ruth and Alan. Like all Rovers of this vintage, it has an aluminum oxide body, which doesn’t rust, and a mechanical design that allows anyone to learn how to make field repairs with the most basic of hand tools. The only serious mechanical

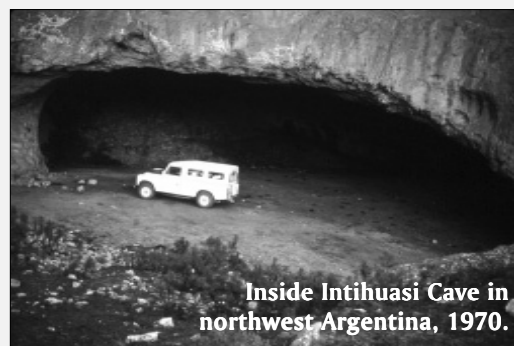
trouble I have ever had was when Alan and Ruth brought it to me in Bellingham, Washington (they drove it over the Rockies, down from Edmonton), where we met at the Northwest Anthropological Conference. After the conference, I drove Alan and Ruth to Seattle, where they were to fly home to Edmonton. As we were crossing the I-5 bridge over Lake Washington, near the University of Washington campus, the Rover sputtered and conked out. I couldn’t get it started, and we subsequently blocked traffic on the West Coast’s busiest highway. Eventually, a state trooper pulled up behind us and pushed us off of the bridge with his cruiser.



Davis at the wheel today.

LOREN DAVIS

We rolled to the other side and they caught a cab to the airport. Ultimately, the problem was just a bad fuel pump. Once that was solved, I drove it back home without further problem. The Rover has been with me on several field projects in the deep canyonlands of western Idaho, in Oregon’s deserts, and along the Pacific coast. It’s not the speediest of vehicles, the smoothest of rides, nor the quietest; however, it has loads of style and it can crawl like a tank over nearly any obstacle. I am very proud to keep it in service, in the pursuit of First Americans research. I know that Alan would be happy to hear that. 



Inside Intihuasi Cave in northwest Argentina, 1970.

RUTH GRUHN

Human Migration into the New World

A New Look at the Genetic Evidence

WHAT MAKES First American studies exciting is that it's a wide-open field. Researchers from a variety of disciplines can contribute—not just archaeologists, but also historians, biologists, geologists, linguists, chemists, geneticists, you name it. There's plenty for all of us to learn. We've yet to answer some of our most basic research questions, and some answers still have voids that need to be filled in. And occasionally someone makes us rethink what we *think* we already know.

Take, for example, recent news from the Ancient DNA Laboratory at the University of Utah. Investigators Dennis O'Rourke and Jennifer Raff, after taking a close look at the genetic markers used to trace when the First Americans arrived and which Old World populations they may have derived from, believe they've pinpointed where the ancestors of the First Americans originated, and they propose an unorthodox path for their migration east—one that brought humans into the New World somewhat earlier than we previously thought. Their initial results, published in the 23



AFTER DENNIS O'ROURKE

Possible migration routes for First American populations into the New World. The Beringian route ——— and the Pacific coastal route ——— were traveled after the last glacial maximum (LGM). The alternative route proposed by O'Rourke and Raff ——— would be the path for a pre-LGM migration. O'Rourke and Raff emphasize that these paths aren't mutually exclusive.

February 2010 issue of the journal *Current Biology*, are intriguing many scholars, and unsettling others.

O brave New World . . .

Over the centuries since European contact, observers have proposed numerous models to explain the peopling of the Americas. One of the first, dating from the 1600s, was that America was originally colonized by Asian groups who traveled overland across some unknown geographic link between North America and Siberia. That connection, now called Beringia, did indeed exist once upon a time; but it's mostly seafloor today and has been for thousands of years. The rise in global sea levels as the ice melted at the end of the Pleistocene inundated the Bering Land Bridge no later than about 10,000 calendar years ago.

Today the idea that humans entered the New World via Beringia is firmly entrenched in modern archaeological thought, if only because it's the simplest explanation. Granted, there are other viable hypotheses, the liveliest of which are variations of the so-called Coastal Entry theory. In this scenario, seagoing Pleistocene cultures skipped down the west coast of North America, colonizing ice-free refuges and advancing into the interior of the continent as the ice sheets receded. The most durable theory, nonetheless, remains migration by the Bering Land Bridge. It's also the most malleable theory, one that is constantly tweaked and adjusted by anthropologists . . . and lately, by geneticists.

By the mid-1960s, linguistic, dental, and genetic evidence had arrived at the general consensus that humans entered the New World via Beringia in three waves, well after the Late Glacial Maximum (LGM) of 22,000 years ago. In chronological order, these waves were designated the Amerind, Na-Dene, and Eskimo-Aleut, the last migration occurring as recently as 3,000 years ago. As further data came in on the archaeological and genetics fronts and this scenario became frayed around the edges, other hypotheses leaped forward to reinvigorate the theory. That's where Drs. O'Rourke and Raff come in. Based on their metastudy of the genetic evidence, they hypothesize a migration model with a somewhat different route and timing than its predecessors.

Most Beringian models focus on the southern coastline of the Bering Land Bridge, which would have led migrants into Alaska and eventually into central North America. But the data also fit an in-migration along the *northern* coast of

Beringia and thence onto the eastern seaboard, with a later and lesser migration into the center of the continent as ice-free routes opened up. We know that modern humans were in northern Beringia 30,000 years ago (**MT 19-3, -4, 20-1**, "Yana River, Siberia: Implications for the Peopling of the Americas"), so it's plausible to wonder if they might have

migrated east during the LGM, when the sea level dropped. This was possible quite early, before the ice sheets established themselves fully. And the truth is, it's a much shorter distance into the New World, skirting that emerging northern coastline, than through central Beringia or along the southern coast.

Although the O'Rourke-Raff model challenges some of the generally ac-

Raff preparing a sample collection at the Nuvuk site at Point Barrow, Alaska, in 2009.



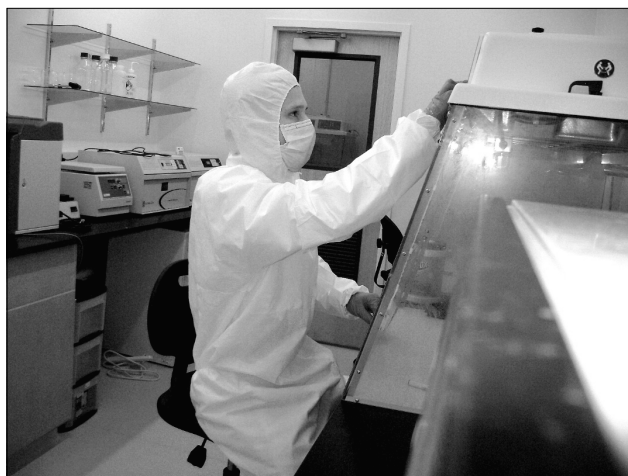
ALL PHOTOS: DENNIS O'ROURKE

cepted ideas about how humans first arrived on American shores, both researchers are quick to emphasize that their model and other hypotheses are not mutually exclusive. Nor do they intend theirs to supplant other models; it's just one more option to consider. "One of the major points of our article is to encourage discussion between geneticists and archeologists," cautions Raff. O'Rourke agrees. "While we think this is an interesting scenario, and we think there's good evidence for it, it's a hypothesis that requires testing—like all other hypotheses."

Birth of an idea

As our view into the past has sharpened, it's become obvious

that the older models of New World colonization require at least a little revision. Under a traditional Beringian model, for example, the closest relatives of the pre-Columbian Native American groups ought to live in northeast Asia—but that's not the case. Most Native American groups (with the



Ph.D. student Justin Tackney in the Ancient DNA Lab, 2010.

exception of the Eskimos and Aleuts, relative latecomers to these shores) share genetic affinities with people from the south-central uplands of Siberia, in the vicinity of the Yenisei River—an area that we know remained ice-free during the LGM. If the continental ice sheets closed late, as O'Rourke and Raff suspect, then the northern coast of Beringia was open just prior to the LGM. This could have served as a conduit from

the Yenisei River region to Baffin Island and other northern routes, allowing early access into Alaska and, to a less extent, into mid-continent.

"All the colonists, coming from that central source population, would have differed in ways that made sense genetically," says O'Rourke. "That was the origin of the concept, that and the fact that there seems to be evidence that the density of Clovis finds is highest in eastern North America, which may be an indicator of population density. Finding a population model that would generate higher population densities early in the East isn't an unreasonable thing to begin to consider."

O'Rourke and Raff were intrigued to discover that although the ancestors of the Native Americans do appear to have derived from south-central Siberia, they're not as closely related to those ancestral populations as initially expected. It's clear to them that at some point in the past, the Native American gene pool must have been isolated, because it differs significantly from the Asian pool from which it clearly derived. When and where in Beringia that period of isolation took place remains an open question, but genetic data confirm that it almost certainly occurred.

One model among many

O'Rourke and Raff are well aware that testing their model will be difficult, despite all they've learned from their recent studies. As O'Rourke puts it, "It might make sense genetically, but the archaeological evidence is much more difficult." That's because very little of the northern Beringian coast still exists. The physical evidence may be there somewhere, but post-Pleistocene climatic changes have sealed it beneath hundreds of feet of frigid ocean.

As O'Rourke and Raff point out, however, their results are comparable to those of other recent studies. Indeed, being a metastudy, their research draws its dataset from the universe of previous studies and extrapolates new possibilities from the results. They aren't arguing that those previous studies are wrong—quite the contrary—and certainly there are other models that would explain their findings. Their primary intention, says O'Rourke, was to demon-

strate that when researchers look at the whole of genetic data and try to place it in an archaeological context, there are gaps and inconsistencies. "Our proposal

is that we should probably start thinking about other ways that people may have come into the New World at other times and by other means," he explains.

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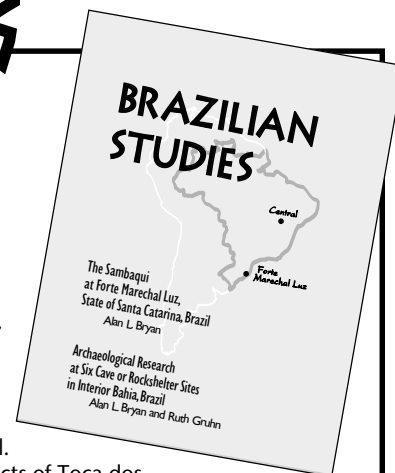
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Raff adds, "We also pointed out directions that other researchers might take in studying the non-mitochondrial markers." That's because nearly all the studies they examined looked at variations in mitochondrial DNA (mtDNA), which comes from cellular structures called mitochondria. This form of DNA passes exclusively through the maternal line. Nuclear DNA (nDNA), found in the center or nucleus of the cell, hasn't been as extensively studied in Native American populations. Nor has Y-chromosomal DNA, which is exclusive to the male lineage.

The response to the new migration model has been mixed thus far, but generally favorable. O'Rourke reports a few skeptical comments from Canadian colleagues, who admit to thinking that it's an interesting hypothesis but point to harsh Arctic environments as a stumbling block. "I've heard no comments that have been exceptionally critical," he says, "because we offered it as a hypothesis that *might* be considered as an alternate or addition to other hypothetical routes of entry. Again, we were also interested in ways that we could make the genetic and archaeological records jibe." Raff reports that her informal discussions with colleagues have produced the same results—they find it intriguing, but are skeptical. "Yet they realize that this is the kind of hypothesis that needs to be put out there, to compare it with others in light of old and new data."

As for recent suggestions that the earliest American populations included immigrants from Europe and elsewhere, neither O'Rourke nor Raff believes that's likely. Most such arguments stem either from comparisons of lithic technologies or from occasional early human remains with skeletal characteristics more typical of Western populations. "I'm not competent to speak about the lithic materials," says O'Rourke, "but the evidence from genetics doesn't support this model. Nor am I aware of any genetic evidence that supports any trans-Pacific migrations." Such migrations would have been necessary for ancient Africans to have intermingled with Native American populations, as has been occasionally suggested.

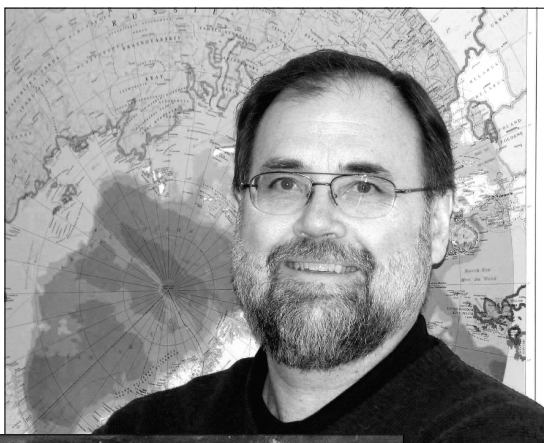
Moving forward by looking backward

Peering into the past has always been a matter of looking "through a glass, darkly." Research like O'Rourke and Raff's is clarifying the image for ancient North America, so that we can better understand our antecedents and their place in history. The rapidly developing field of bioinformatics (a melding of computer science and biology) promises a much sharper image in the next few decades. Meanwhile, basic genetics research continues apace. There's still a lot to be done, of course. Among other things, we need more informa-

tion about Y-chromosome variation in Native American populations. That database is growing, but it's not nearly so extensive as mtDNA records. "What we *really* need," O'Rourke points out, "is more information about the nuclear genome among widely dispersed populations in the New World." He would also like to see an effective combination of the nDNA, mtDNA, and Y-chromosome research to provide a richer picture, one that allows researchers to use better tools (including simulation tools) to provide them with wider, more plausible models that they can rigorously test.


Existing DNA studies can only take us so far, because most come from genetic assays of modern Native American populations—people who have been intermarrying into other populations for more than five centuries. To truly understand who the First Americans were, we require *their* genetic material,

not that of their descendants 500 times removed. In other words, "We need to see a lot more ancient DNA," Raff says. "More direct data would have to come from much older samples—not too many of which are out there." What's worse, it's difficult to extract viable genetic material from those older remains; although traces of DNA do sometimes re-



The authors of the study,
O'Rourke (2008) and Raff (2009).

main in ancient skeletal material, it's subject to the same preservation problems that affect everything else organic. Fortunately, though, the methodology is getting to the point where researchers can extract much better information than was possible even a few years ago.

"We're getting a very good picture of ancient variation 3000–5000 RCYBP, but older material is still very sparse," states O'Rourke. "Ancient DNA would be very instructive, allowing us to anchor what we know from the modern variation to points in the past." 

—Floyd Largent

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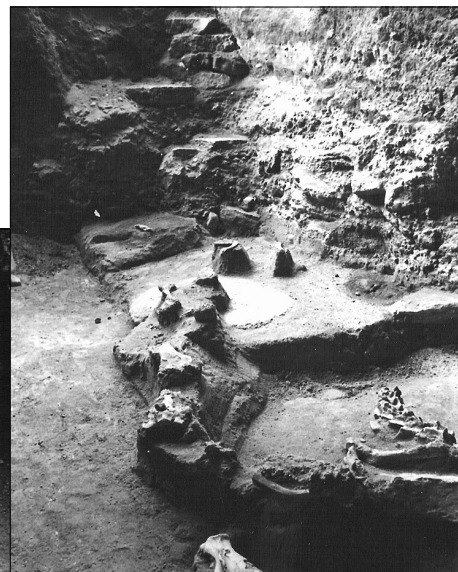
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Paleo South America

Long Time, No See

ONCE THE DOMINANT hypothesis on the peopling of the Americas, the Clovis-First theory asserts that the first colonists from Northeast Asia crossed the Bering Land Bridge about 13,000 calendar years ago and populated the entire hemisphere in a north-to-south migration. The theory has been tottering since the discovery of pre-Clovis occupations at Monte Verde in Chile and at sites in North America. Some authorities have attempted to salvage it by proposing alterations. The Coastal Entry theory, for example (MT 24-3, "Putting MUSCLE into Coastal-Entry Research"), suggests that migrants traveled by watercraft rather than overland on foot. A recent variation of the theory proposes that the initial migrants crossed the Land Bridge thousands of years earlier than previously thought, then traversed Canada, before ice sheets closed the passage, and continued their south-bound migration ("Human Migration into the New World: A New Look at the Genetic Evidence," this issue).

Genetics studies of American populations support a migration from Beringia southward through the Americas (MT 24-4, "Genetics Study: Two Paleoindian Migration Routes into the Americas"). But the archaeological record doesn't agree. Skeptics argue that sites should decrease in age the farther south they lie, but the data, although regrettably sketchy, appear to refute this. "It's a puzzle," says James Steele, with the AHRC Centre for the Evolution of Cultural Diversity, Institute of Archaeology, University College London, "that we don't see an obvious north-south gradient in arrival times for the earliest established settlement of North and South America." Realizing that the issue couldn't be resolved with the existing suite of inconclusive radiocarbon dates for South American sites, Dr. Steele and his colleague, Dr. Gustavo Politis from CONICET—The Universidad Nacional del Centro de la Provincia de Buenos Aires, undertook a project to refine the dates for key sites in southernmost South America. Their methods and re-


BOTH: DIVISION OF ANTHROPOLOGY, JUNIUS BIRD ARCHIVE, AMNH

A mere three years after the first Clovis point was discovered at Dent, Colorado, Junius Bird traveled to the southernmost tip of Argentina (MT 23-4, 24-1, -2, "In the Footsteps of Junius Bird"). At Fell's Cave in 1936-37 he found the scapulae of fossil horse *Onohippidium* (left), and remains of *Onohippidium* and ground sloth

(*Mylodon* sp.) (above), associated with abundant lithic artifacts. Radiocarbon dating in the 1960s established the time of the occupation at about 11,000 RCYBP. That humans were present in the New World at the same time as Clovis people, and at a point 6,000 miles distant, is a conundrum that has been largely ignored by North American anthropologists. In this article scientists Gustavo Politis and James Steele address the issue of early Americans in South America.

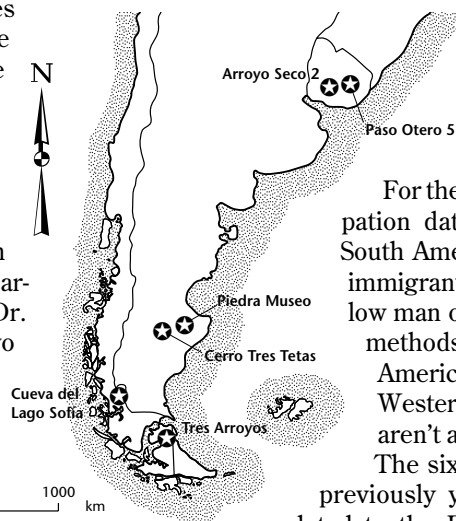
sults can be found in their article published in the 2009 issue of *Journal of Archaeological Science*, "¹⁴C Dating of Early Human Occupation of Southern South America."

The object of their undertaking was to establish a firm time of appearance of a "demographically viable hunter-gatherer population in late-Pleistocene southern South America."

Setting our 'sites' on the Pleistocene

For the record, sites bearing evidence of human occupation dating to the Pleistocene abound throughout South America. Considering the routes supposed initial immigrants are likely to have taken, South America is the low man on the totem pole. But regardless of theorized methods of travel or routes taken, the fact is that South America claims as much antiquity as the rest of the Western Hemisphere. It's just that North Americans aren't always paying attention.

The six sites Steele and Politis chose to redate had previously yielded solid evidence of human habitation dated to the Pleistocene. Four of the chosen sites lie in



Argentina. The first, Arroyo Seco 2, located near the town of Tres Arroyos about 50 km north of the Atlantic coast, has multiple occupation components dating to the Pleistocene/Holocene transition; several occupation levels possibly date to the late Pleistocene. Remains from a number of extinct megafauna were discovered in this lower component, Politis and Steele explain, and three genera (*Equus*, *Hippidion*, and *Megatherium*) bear “evidence of human exploitation.” An assemblage of unifacial retouched tools was present in this lower layer. Bones associated with these tools had previously yielded dates between approximately 12,240 and 7320 RCYBP.

The Holocene component of Arroyo Seco 2 contains the graves of 44 persons. Some graves penetrate Pleistocene sediments. These are the resting places of hunter-gatherers who lived in early- to mid-Holocene times—grave diggers, it turns out, disturbed deep subsoils. (Unwary archaeologists, beware!) This site provides an example of continuous occupation from the Pleistocene into the Holocene.

East of Arroyo Seco 2 is Paso Otero 5 on the bank of Río Quequen. This single-component site was buried beneath 2.5 m of Holocene flood-plain sediments. It contained the remains of animals extant at the time, as well as an artifact assemblage that hints at a date at the Pleistocene/Holocene transition. Also discovered were two fractured Fishtail points. This type of point has a long, thick stem from which it derives its name (MT 25-1, “Early Human Occupation in the NW Plains of Uruguay”). Fishtail points are consistently found in layers dating to 10,000–11,000 RCYBP and are therefore considered a reliable marker. Some Fishtail points have fluted stems, but put on the brakes before thoughts of Clovis kinship start to rev up. Chronologically they almost overlap Clovis (11,050–10,800 RCYBP). They are, in fact, so nearly contemporaneous that in Politis’s view the considerable geographical distance between the two renders unlikely a sibling or ancestor-descendant relationship. The rest of the assem-

blage also showed clear signs of burning, and analysis revealed the temperature surpassed that of a mere grass fire attributable to natural causes. The oldest previous AMS date from the excavation, taken from a burnt megamammal bone, was $10,190 \pm 120$ RCYBP.

Far to the southeast of these first two sites is Piedra Museo, a rockshelter site in the Santa Cruz province. Its lower levels revealed a fragment of a Fishtail point and bones. Several AMS dates had previously been obtained, the oldest from charcoal dating to $12,890 \pm 90$ RCYBP.

To the southwest is the last Argentinean site, Cerro Tres Tetas, which has multiple components. Its lower component yielded 500 lithics such as scrapers, bifacial tools, and even a hammer near the bones of *Lama guanicoe*. Charcoal from a hearth had dated the site to $11,560 \pm 140$ RCYBP.

The last two sites are located in Chile, the first being



Politis (left) in Brazil, 2008, and Steele.

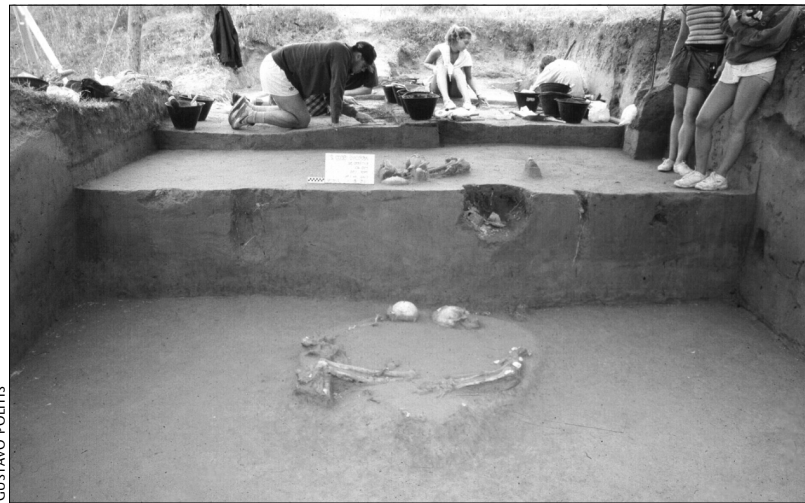
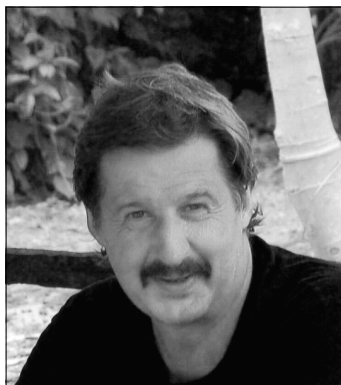
Cueva del Lago Sofia 1. Discovered within this cave was a hearth together with the bones of extinct megafauna, flakes, and bone tools. Two dates were taken from this level. The oldest, $12,990 \pm 490$ RCYBP, is discarded by some because it was taken from an unmodified bone. The other, however, is still reasonably old, dating to $11,570 \pm 60$ RCYBP. The last site, Tres Arroyos, on the island of Tierra del Fuego just west of the Chile-Argentina border, contains hearths, bones, and retouched artifacts, all clearly associated. Carnivores, active at the site when the earliest cultural layers accumulated, may have contributed to the animal bone assemblage. The oldest date previously obtained from this site (by Massone in 1987) was $11,820 \pm 250$ RCYBP, on a calcined bone sample from a hearth.

Politis confesses fascination with other sites, such as Taima Taima to the north in Venezuela, whose dates beg for closer scrutiny or redating with current technology. There are, unfortunately, so many such South American sites that it was impossible to redate them all in one project.

The best dates, to date

Politis and Steele chose six sites according to exacting criteria. First, each site must present “undeniable traces of humans . . . in undisturbed geological deposits.” New radiocarbon dates obtained from such sites had to be “statistically precise” with less than 300 years

Excavation of the Arroyo Seco 2 site during the 1996 field season exposed several levels with burials. The upper burial dates to ca. 6300 RCYBP, the lower burial to ca. 7800 RCYBP. Several bifacial projectile points (triangular and lanceolate, not stemmed) were found in bodies in the lower burial.



error in either direction. AMS testing needed to be done on “taxonomically identified objects of carefully cleaned cultural carbon” found associated with artifacts. Lastly, these sites must have stood the test of peer review. “We wanted to make sure our dates were the best,” Politis sums up. The preexisting dates for each of these six sites suggested South American occupation occurring simultaneously or even earlier than the North American measuring stick, Clovis.

When selecting specimens to be dated, Politis and Steele’s first choice was for either hearth charcoal or animal bones bearing unmistakable cutmarks. When such objects were not available, burnt or helically fractured bone was chosen where available. (Helically, or spirally, fractured bone identifies bone smashed or broken when green, possible evidence of human modification; see **MT 23-1**, “Early Mammoth Bone Flaking on the Great Plains.”) Such was the case with Arroyo Seco 2, where four pieces of helically fractured megamammal bone were selected as specimens. From Paso Otero 5 six fragments of bone were collected, three burnt, one possibly burnt, and two unburnt. The assortment taken from Piedra Museo included three charcoal and three bone specimens, one with cutmarks

A Fishtail point from the hill atop the Cerro El Sombrero site in Argentina. Bird found Fishtail points in Fell’s Cave. They appear in both fluted and unfluted forms and are as emblematic of the earliest South American Paleoamerican culture as fluted points are of the Clovis culture in North America (MT 25-1**, “Early Human Occupation in the NW Plains of Uruguay”).**



and the others helically fractured. Cerro Tres Tetas supplied two samples of charcoal from a single hearth. Six bone specimens were collected from Cueva del Lago Sofia 1, one of which was culturally modified for probable use as a retouching tool. Tres Arroyos supplied a single piece of charcoal and five unmodified bone fragments (four from the cultural layer, another from the layer above).

AMS radiocarbon testing was done by the Oxford Radiocarbon Accelerator Unit and to a lesser extent by the University of Arizona NSF Facility. Politis emphasizes the necessity of repeatability in radiocarbon dating: A date that can’t be duplicated invites skepticism. The results of his and Steele’s recent testing score high marks. They report that “inter-lab repeatability was very high for three of the charcoal specimens.” Repeatability of results for the bone specimens wasn’t as high, but Politis and Steele point out that burnt bone specimens are unreliable radiocarbon-dating samples because of reduced collagen content and carbon contamination from sediments.

The specimens selected from the South American sites yielded spotty results. Some lacked sufficient carbon and failed to provide dates. Others, however, were more forthcoming.

Long time . . .

The oldest materials were those from Arroyo Seco 2,

megamammal bones with helical fractures—likely made by humans while extracting marrow or quarrying bone—and found in association with lithic artifacts. Bones of *Equus* and *Hippidion* returned C-14 dates of c. 11,200 RCYBP; of *Toxodon*, c. 11,750 RCYBP; and of *Megatherium*, c. 12,150 RCYBP. These dates are consistent with previously obtained determinations on samples from the same species and even from the same bones at the site, and therefore seem reliable. The ages are also consistent with known extinction chronologies of the megamammal species themselves. What is remarkable is the possible association with human activity—to appreciate this, consider the range of dates for Clovis sites in North America, which is about 11,200–10,900 RCYBP.

Paso Otero 5 gave sketchy results. Only one of the six bones provided usable information. Although its date compares favorably with the preexisting date, the burnt condition makes it

impossible to tell if the bone indeed bears cutmarks. It was, however, found in “close stratigraphic relationship with fractured Fishtail Points and . . . had been heated to a high temperature.” Politis and Steele have dated human occupation at the site at 10,340 RCYBP. This is considered a tentative date, however, because of problems of sample quality.

Piedra Museo provided a stratigraphically consistent series of new dates, which Politis and Steele had to sort through. Previous testing had dated one charcoal sample at $12,890 \pm 90$ RCYBP, but this date was never reproduced, and Politis and Steele therefore dubbed it an outlier. Another pre-existing charcoal date dated to $11,000 \pm 65$ RCYBP, but the new results didn’t reliably reproduce that

age for other samples in the same layer, so the team decided it needed to be evaluated further before they could draw any conclusion. Playing it safe, Politis and Steele settled for the time being on the more consistent younger dates of two Piedra Museo occupations, c. 10,700 RCYBP and c. 10,400 RCYBP.

Politis and Steele had two charcoal samples from Cerro Tres Tetas tested at both labs. Their average doesn’t approach the previously documented date, which was slightly more ancient, but the concurrence of the new dates from separate labs persuaded Politis and Steele to reject the previous, older date. Curiously, the two charcoal specimens, although taken from the same hearth, aren’t congruent in age (the source wood for one charcoal sample was somewhat older than for the other). The possibility that this feature was reused after an interval would explain the disparity, but with no way to know for certain Politis and Steele can only adopt the younger date of c. 10,900 RCYBP, with the possibility that the hearth was used earlier around 11,100 RCYBP.

Unable to reproduce the preexisting date on the charcoal specimen from Cueva del Lago Sofia 1, Politis and Steele determined that further tests are needed on charcoal from this hearth feature. The date from the bone retoucher, however, was compatible with a dated horse bone. With this more stable evidence, Politis and Steele place the date at c. 10,700 RCYBP.

As for Tres Arroyos, the team was unable to duplicate the oldest of the previously documented dates. Nevertheless their charcoal date agrees with previously documented dates from two other hearths, and Politis and Steele are comfortable assigning a date of c. 10,600 RCYBP.

... no see

If we weren't sitting up and taking notice before, these new dates ought to get our attention. When it comes to ancient Americans, southern South America has as much to brag about as anywhere else. Politis and Steele's results confirm what farsighted North American scientists like Junius Bird and Alan Bryan and Ruth Gruhn have been telling us for more than a generation, that South America deserves our attention in First Americans studies at least as much as does North America. The megamammal bones from the oldest deposits at Arroyo Seco 2 are "one or two thousand years older than Clovis," Politis frankly tells us, "but not 20,000." In fact, Arroyo Seco 2 now rivals the Alaskan Swan Point site in age.

Nonetheless we mustn't allow these particular dates (and the debate they will likely stimulate when the Arroyo Seco 2 excavation monograph is published in the near future) to distract us from the point of Politis and Steele's project, which was to evaluate radiocarbon evidence for early human occupation at multiple sites in South America. Here the abstract from their article speaks eloquently of their findings:


Considered alongside recent age estimates for the Clovis culture in North America, these results imply the contemporaneous emergence of a consistent and archaeologically-robust human occupation signal at widely-separated locations across the Western Hemisphere. Such findings suggest that Palaeoindian demic expansion may have involved more than one terminal Pleistocene dispersal episode.

The Paleoindian Menu

continued from page 4

short-term gains at the expense of long-term costs. It's an enduring consequence of the human condition. Witness the Easter Islander that cut down the last tree, or the American hunter that shot the last passenger pigeon. "We study modern foragers today," says Surovell, "and we generally see very little concern for conservation until there seems to be social benefit for it, like when there's a major perceived social cost to culture and to

They discovered that it is no easier to explain the apparently simultaneous occupation of sites across the breadth of two continents by a single southbound migration—simultaneous when considered on an epochal time scale—than to hypothesize a migratory scheme that would disperse the Clovis culture across the width and breadth of North America in less than 600 years.

The study of the First Americans is not yet a completed task. 

—K. Hill

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Suggested Readings

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myself—gas going up dollars a gallon, for instance. It's absolutely the case that humans make the same mistakes over and over again." 

—Katy Dycus

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Suggested Readings

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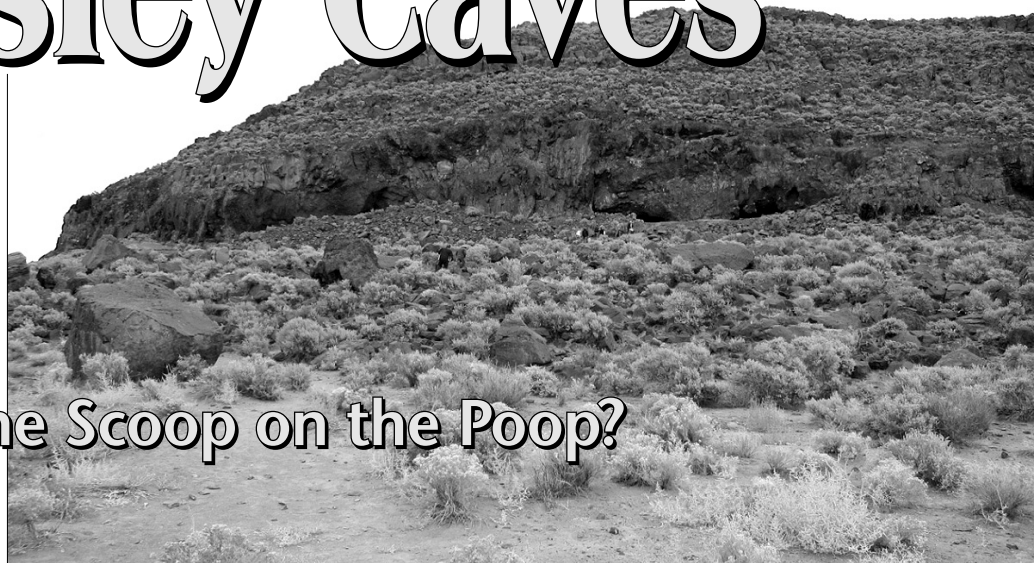
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Paisley Caves

Part I: What's the Scoop on the Poop?



MICHAEL R. WATERS

IF YOU FOUND a pre-Clovis site, what would it look like? Would the assemblage have blades and fluted bifaces? Microblades and composite spear points? Crude chopping tools and flakes? This is a fundamental question that dogs archaeologists working on the peopling of the Americas: If we found pre-Clovis assemblages, would we even recognize them?

Sites that in recent years have claimed a pre-Clovis component have been greeted with a mix of skepticism and eager welcome. In most cases, claims for antiquity rest on the uneasy co-occurrence within strata of lithic artifacts and datable, non-cultural organic remains. For each site, plausible scenarios can be imagined that integrate older organic materials with younger lithic artifacts. Doubt is fueled by the lack of fit between the artifacts found and our individual expectations for what a pre-Clovis lithic assemblage should look like.

For many archaeologists, the only acceptable evidence of a pre-Clovis occupation of North America would resemble that jokingly offered up by Dennis Jenkins, a Senior Staff Archaeologist with the University of Oregon Museum of Natural and Cultural History: a camel skull with a projectile point in the bone of the eye socket with evidence that the camel got away, and bone grew around the point. In this unlikely scenario, bone preservation would be excellent and multiple AMS dates on multiple bone fractions would yield a tightly overlapping cluster of dates before 11,500 RCYBP (13,500 CALYBP).

Which is why Dr. Jenkins's finds from the Paisley Five-Mile Point Caves in south-central Oregon took everyone by surprise: pre-Clovis AMS dates on human coprolites (mummified feces) in association with the bones of extinct megafauna and a small assemblage of lithic debitage, a drill fragment, and a Western Stemmed Tradition projectile point.

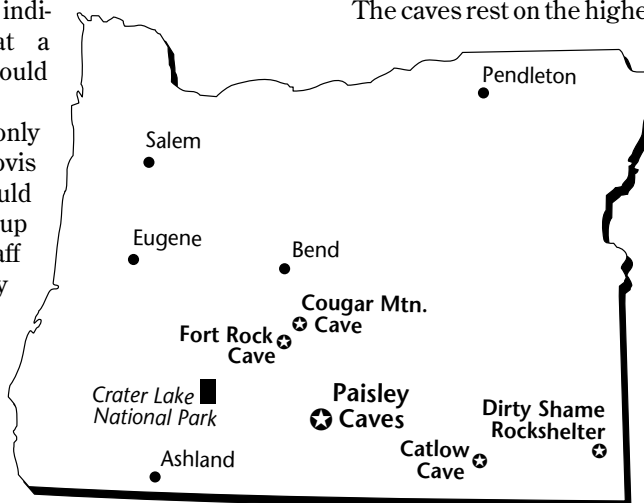
A relict from wetter and gentler times

The seven Paisley Caves are bunched together on a small basalt promontory that juts out of the eastern side of the Summer Lake Basin. The caves were created by wave action on the downwind side of Pleistocene Lake Chewaucan, which covered the valley floor until sometime around 16,000–17,000 RCYBP. The caves rest on the highest shoreline left by this ancient lake.

Silted over for more than 14,000 years, the mouths of the caves are barely visible from the flats 25 m below. From the caves there is a fantastic view of the Summer Lake Basin, with the glittering shallows of its namesake nestled under the brow of Winter Ridge a dozen miles to the west.

About 14,500 years ago, much of this sagebrush-and-greasewood-covered valley lay under Winter Lake (Pleistocene Summer Lake). Conifer woodland stretched from the cattail and bulrush flats along the lake margin up past Paisley

Cave and east to the Sharptop plateau. Waterfowl and fish swam in the shallows while horse, camel, bison, and other fauna shared the shoreline with rabbits, hares, coyotes, ante-



lope, and elk. If Jenkins is right, pre-Clovis human hunters wandered this landscape, hunting the abundant fauna near the caves and collecting plants by the shore.

The Paisley Caves have been in the running for recognition as a pre-Clovis site since the late 1930s when Luther Cressman excavated here in an attempt to establish the deep antiquity of humans in the Americas. Working before radiocarbon dating was invented, Cressman's data from Paisley Caves showed that humans were in the region prior to 7630 CALYBP, when Mt. Mazama erupted to form Crater Lake and in the process blanketed southeastern Oregon with ash and pumice. In the caves, sediment below the ash yielded a hearth, lithic artifacts, and the bones of Pleistocene horse, camel, and other fauna. The lowest levels provided a tantalizing glimpse of late-Pleistocene life, but the lack of detailed, published stratigraphic data made it impossible to sort out cultural and non-cultural elements in what were generally thought to be heavily bioturbated strata.

An archaeologist's work cut out for him

When Jenkins first visited the Paisley Caves, he recalls that the site "looked horrible," since Cressman had not backfilled his units and the site had been heavily looted. Despite the site's appearance, Jenkins was undaunted: "I can find undisturbed deposits here," he remembers thinking. So, in 2002 Jenkins initiated the first of five summers of excavation at the site with one simple goal: to assess once and for all whether Cressman really had discovered artifacts in tight association with hearth features and extinct megafauna.

Many outsiders thought Jenkins was on a fool's errand. Veteran Great Basin zooarchaeologist Don Grayson recalls thinking that "it's an interesting idea, but not much will come of it."

The caves are small. Cave 5, for example, measures approximately 6 m deep by 9 m wide by 2–3 m tall. The small floor is littered with fallen basalt blocks, some too large to remove without fracturing. The majority of the deposits are dominated by windblown silt and organic matter, which consists mainly of

animal fecal pellets, food remains, and nesting materials. The early materials have been recovered from Cave 5 and, more recently, from similar strata in Cave 2. Two stratigraphic units have been identified in Cave 5 below the layer of Mt. Mazama ash:

- Stratum 2 is a layer of brown sand containing a moderately sorted mix of fine sand to silt-sized sediments, gravel, macrobotanical remains, and packrat fecal pellets. This deposit is sandwiched between the Mazama tephra and the underlying basal sand deposit containing the bones of horse and camel. Strands of thread made of grass fiber and processed sinew were found in this level, along with a willow dart butt and a spatula made from a bison horn core. An AMS date of 12,750 CALYBP was returned on three of the grass threads, making them among the earliest examples of twining in the Americas. According to Jenkins, the lower levels of stratum 2 had the highest artifact concentrations at the site, "hundreds of pieces of lithic debitage, scrapers, bifaces, wooden



ANDREW CURRY

Jenkins excavates a piece of megafauna bone in Cave 5.

artifacts, lots of large mammal bone, polished stone, cordage and basketry elements."

- Stratum 1 is a layer of sand containing carbonate lenses and evidence for two short periods of soil development. In Cave 5 a few artifacts, bones of extinct animals, and human coprolites have been recovered from this stratum, which is described as a poorly sorted gravelly deposit containing abundant packrat



BRIAN LANKER

fecal pellets, organic materials, and fine sand to silt-sized sediment. In Cave 5, stratum 1 dates between 13,140 and 15,900 CALYBP, similar to the date range for this deposit in Cave 2.

While the cultural materials from stratum 2 are

Spatula 12,000 years old made from the core of a bison horn.

outstanding, particularly the preservation of organic materials, it's the pre-Clovis deposits that have provoked controversy. In these deposits, which lie over and between boulders rounded by the ancient lake that carved this cave, Jenkins and his students have recovered camel bones: a vertebra, an astragalus (ankle-bone), and foot bones. The astragalus produced an AMS date of

14,290 CALYBP, some 700 years prior to the start of Clovis. In the same deposit, the bones of bison, goat, and horse were also discovered, along with the remains of birds (swan, goose, heron, seagull, and sage hen), small mammals, and fish. A large mammal bone with probable butchery marks was AMS dated to 14,310 CALYBP; another bone was AMS dated to 14,230 CALYBP. Bioturbation was evident in the deposit, but stratigraphic integrity overall was demonstrated by the consistency of the majority of radiocarbon determinations with depth. Lithic debitage quantities were sparse, with the majority of debitage



Gathering coprolites ▲
(on Jenkins's Website described as
"Collecting Poo") in Cave 2.

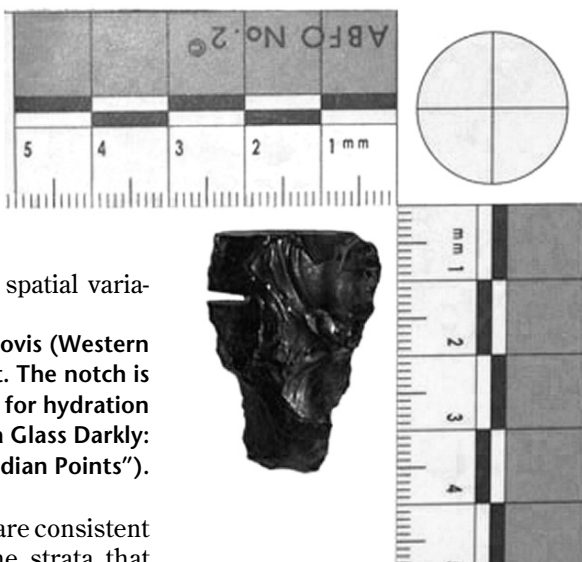
Human coprolite 1374-PC-5-5D-31-22. ►

traceable to the nearby Tucker Hill and Coglan Buttes obsidian sources. Obsidian from both sources is present in the Pleistocene lake gravels near the site.

Coprolites and contaminants

None of the contents of this stratum have proven as contentious as the coprolites. Excavations in the lowest levels of the cave produced 14 coprolites that can be attributed to humans based on size and form. AMS dates on plant fibers from three of these coprolites produced dates between 14,170 and 14,340 CALYBP, a few hundred to a few thousand years before Clovis. Except for a probable fractured long bone, no datable organic artifacts have been reported from the same levels as the oldest coprolites. Assemblage-scale obsidian hydration measurements on five pieces of debitage from those levels, recalibrated based on within-site spatial varia-

Base of an obsidian pre-Clovis (Western Stemmed tradition) point. The notch is where material was removed for hydration dating (MT 23-3, "Through a Glass Darkly: Dating Obsidian Points").



tion in temperature and moisture, are consistent with the AMS date ranges for the strata that contained the coprolites: A biface fragment recovered from the back of Cave 5 in the north block produced an obsidian

hydration date of 14,260 CALYBP, and a stemmed point produced an obsidian hydration date of 16,540 CALYBP in strata dated to 13,260 RCYBP (15,900 CALYBP).

Jenkins partnered with University of Copenhagen geneticists Dr. Eske Willerslev and Dr. M. Thomas P. Gilbert, who applied advanced biomolecular methods to determine whether the ancient coprolites, whose overall size, shape, and color suggested human origin, were actually human. Fourteen coprolites were initially screened for human mitochondrial DNA (mtDNA) using multiplex PCR (polymerase chain reaction) and minisequencing. In multiplex PCR, a sample of genetic material is compared with a series of mtDNA fragments of known sequence called primers. If the genetic sequence of mtDNA fragments in a sample matches that of a primer, then multiplex PCR

replicates the mtDNA fragment in large quantities. Minisequencing is used to determine the genetic sequence and therefore the identity of the replicated fragments.

In the case of the coprolites, the primers used were fragments of mtDNA where known differences exist in the genetic sequence of modern human populations. These differences,

thought to be diagnostic of particular points of origin, identify human groups, termed haplogroups, that share common ancestry. Human mtDNA extracted from six of the coprolites contained SNPs (single-nucleotide polymorphisms, places in the genetic code that differ by one base pair between groups)

diagnostic of Native American founding haplogroups A2 and B2. These findings were replicated independently by labs at the University of Uppsala, Sweden, and the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

CIEP (crossover immunoelectrophoresis) was performed on 10 specimens, including the 3 oldest coprolites. CIEP is a method for detecting the presence of specific proteins in organic remains such as blood, blood residues, or tissue. The scientists reasoned that if the coprolites are human, then proteins present in the samples should react to the human-protein antigens used in CIEP. (Proteins enter fecal matter during the passage through the gut.) Two of the oldest coprolites tested positive for human protein.

Jenkins readily admits that contamination by modern DNA is a serious concern in his study. To control for this, his team sent split samples to three independent labs specializing in ancient human DNA. He also used a variety of techniques to establish that no genetic linkage exists between the coprolite mtDNA and the mtDNA of any of the 67 individuals who may have contacted the samples. The downward seeping of later genetic material via percolating water was also controlled for by analysis of sediment samples and by analyzing the coprolites for packrat DNA, since any percolating water would also have picked up packrat DNA as it trickled through layers of packrat fecal pellets and solidified urine. Jenkins's team found no evidence for contamination. These results, they assert in their article in *Science*, "strongly suggest leaching of DNA is not a concern in the Paisley Caves."

A small pre-Clovis lithic assemblage

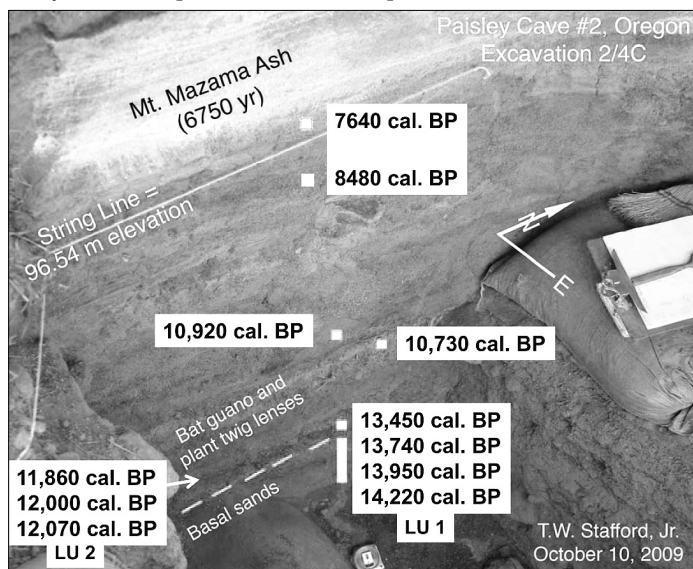
Coprolites aren't the only materials from the lower levels. According to Jenkins, although "horse and camel bones have been found with lithic debitage in good stratigraphic contexts,"

in the pre-Clovis strata, the assemblage is "thin and composed predominantly of debitage. Obsidian hydration [dating] of one stemmed point fragment suggests it is pre-Clovis in age. A polished hand stone in these deposits produced CIEP results indicating horse protein was fixed in the surface."

Despite the meager assemblage, Jenkins is confident that what he has is pre-Clovis in age. "The dating of coprolites with ancient human DNA in deposits containing lithic artifacts and extinct mammal (horse and camel) to the same time suggests that people were indeed occupying the caves when the bones were deposited."

"I think the greatest contribution of the Paisley Caves has been and will be that we have

The strata in Cave 2.



definitely established a human presence beyond Clovis," Jenkins asserts. "This is an extremely important site. We've made some incredible discoveries."

Dr. Grayson concurs: "I only accept two sites in the Americas as pre-Clovis in age: Monte Verde and Paisley Caves. I am absolutely convinced of the authenticity of the Paisley Caves site."

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On the Trail of the Domestic Dog

continued from page 7

came from." Savolainen claims that the D clade represents the dog/wolf mixture. "What we're sure about is that there are totally unique mtDNA types," he says.


Arriving in the Americas

What does all this science have to do with the peopling of the New World? To help answer that question, we bring in Renee Walker, associate professor of Anthropology at SUNY Oneonta. Dr. Walker began studying faunal remains at Dust Cave in 1994 as a doctoral candidate and teaching assistant. Dust Cave, an archaeological site in northwest Alabama dating from late Paleoindian through middle Archaic (10,650–3600 CALYBP), is an example of early dog-human relationships. "The deliberate burials of the dogs tells us that there was either a special secular relationship or a sacred relationship between humans and dogs," she says. "In fact, it is probably both. The uses of dogs as pack animals suggest to me that they were valued members of the group, and literally carried their own

weight. The burial of dogs in the same area of the site, and in at least one case *with* another human, indicates a sacred relationship."

Walker notes that the four dogs buried at Dust Cave measure 39–46 cm at the shoulder; these are very small animals but consistent with the Koster dog burials and other dog burials in the Midwest and Southeast. Like Mike Wiant, principal investigator of the Koster site in Illinois, Walker believes that these early American dogs—whether domesticated or not—provided an essential support system as people came into the Americas: "They carried packs, helped with hunting and camp protection, and were also a readily available source of meat, but I don't think this was a regular case, because most of the dog remains from North America do not consistently show butchering." Unfortunately, science can't determine what function, apart from their utilitarian value, dogs filled for these first Americans. Walker believes they served symbolically as guardians or guides. "This is difficult to address archaeologically," she allows, "but in the ethno-historic record, dogs are mentioned as being guardians or guides for people in the afterlife." Though people would have colonized the Americas without

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But the tide of professional opinion is still out in many researchers' minds. . . . 

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Suggested Readings

Gilbert, M. T. P., et al. 2008 DNA from Pre-Clovis Human Coprolites in Oregon, North America. *Science* 320:786–89. DOI:10.1126/science.1154116

their canine companions, Walker is certain that dogs made things easier.

Connecting to the past

Wayne stresses the importance of the emerging trade industry among Stone Age people in explaining patterns of genetic diversity in dogs and understanding diversity in relation to domestication. Though Savolainen and Wayne arrived at different conclusions regarding the origin of dog domestication, both scientists are dedicated to further research in this area. Wayne's team believes that a few regions in the genome where they have noted exceptional differences between dogs and wolves might harbor clues about what makes dogs and wolves different from each other today. Savolainen agrees that these regions are good candidates for follow-up research

For her part, Walker is content to keep an open mind. "I think we will see changes come as more people investigate this issue. That being said," she continues, "I don't think that the new Middle East data disprove Dr. Savolainen's data. I think that dogs were domesticated several times over the millennia and over a large geographic area." She is convinced that the audience for this debate is far-reaching, with "both academic and esoteric impacts." Academically, it raises a series of fascinating questions. What's more, Walker finds the discussion helps people relate to the past. "Whenever I give a lecture or talk about my dog research," she says, "I get lots of people from the general public and they find it really interesting—particularly dog lovers. I think it helps them connect to the past in a way that might not be possible with other aspects of archaeology." 

—Katy Dycus

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Science Daily, University of Oregon 3 April 2008 Pre-Clovis Human DNA Found in 14,300-Year-Old Feces in Oregon Cave is Oldest in New World. *Science Daily* Website <http://www.sciencedaily.com/releases/2008/04/080403141109.htm>

For a description of the work to date and plans for summer 2010, visit the Website for the University of Oregon 2010 Summer Session, Northern Great Basin Prehistory Project, Archaeology Field School, http://www.uoregon.edu/~ftrock/paisley_caves_description.php

For a description of the current protocol for the collection of coprolites, visit the Website of D. L. Jenkins, Protocol for Collection of Coprolites for DNA Analysis, http://www.uoregon.edu/~ftrock/pdfs/protocol_coprolite_collection.pdf

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Suggested Readings

B. M. vonHoldt et al. 2010 Genome-wide SNP and Haplotype Analyses Reveal a Rich History underlying Dog Domestication. *Nature* 464, 898–902 (17 March 2010).